PB 187 311

GAINESVILLE COMPOST PLANT

Gainesville Municipal Waste Conversion Authority, Incorporated
Gainesville, Florida

1969

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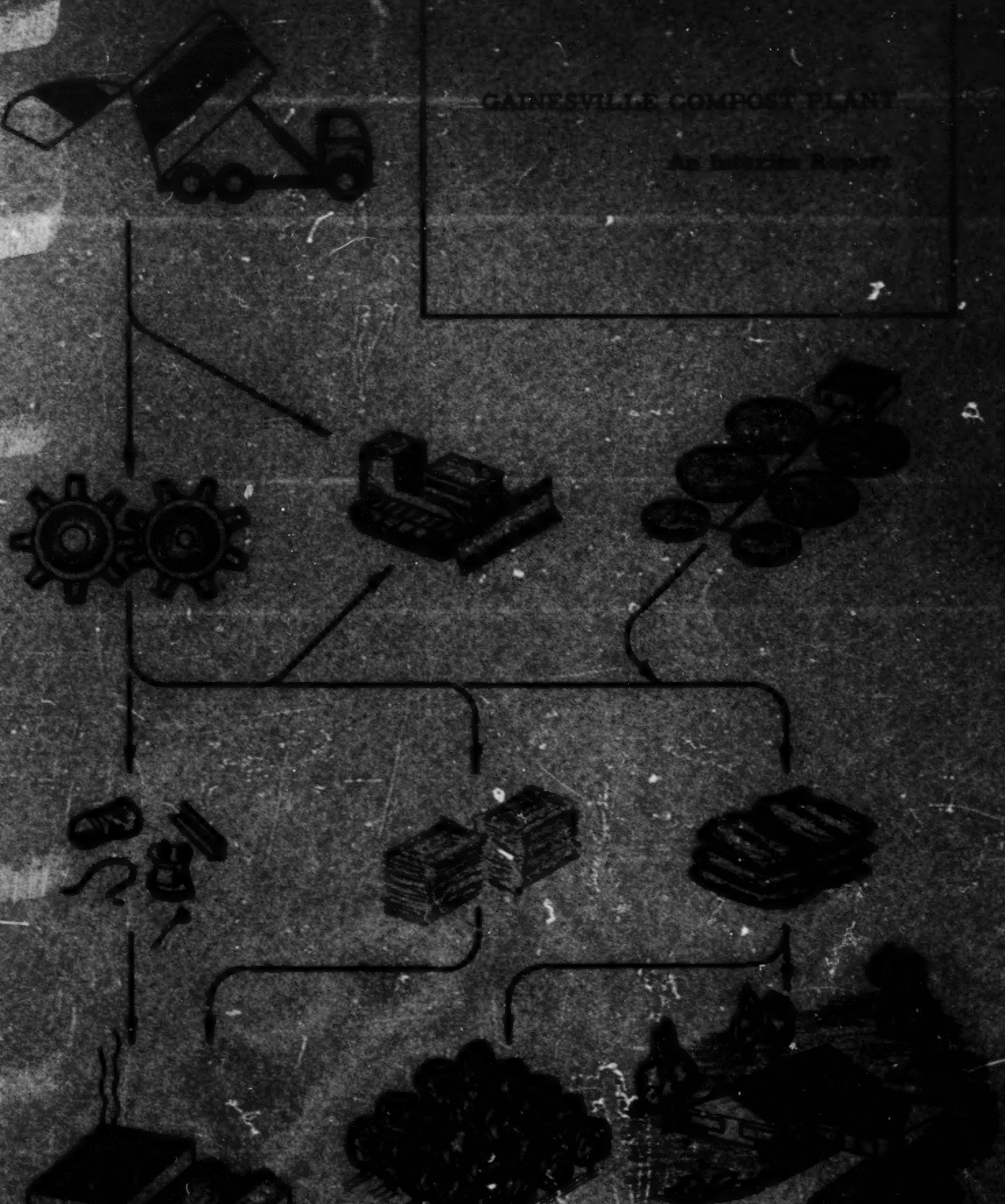
GAINESVILLE COMPOST PLANT

An Interim Report



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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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This report is reproduced as received from the grantee. No editorial or other changes have been made, although a title page, foreword, and abstract of the related demonstration grant project have been added as well as a listing of other reports of solid waste demonstration projects.

Since this is an interim report of progress, the conclusions and recommendations presented should be considered as preliminary in nature, pending completion of the project and final evaluation of findings.

PB-187-311

GAINESVILLE COMPOST PLANT

An Interim Report

This report was prepared by the Gainesville Municipal Waste Conversion Authority, Inc., under Demonstration Grant No. D01-UI-00030. It includes the 1967, the January to April 1968, and the May to August 1968, interim progress reports.

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Consumer Protection and Environmental Health Service
Environmental Control Administration
Bureau of Solid Waste Management
Cincinnati
1969

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PREFACE

An estimated 900 million pounds of wastes in the solid state are produced in the United States every day. What to do with these solid wastes, how to dispose of them without needlessly endangering public health and welfare, and how to recover and reuse valuable materials now "thrown away" are among the most challenging and perplexing of current national problems. Because of lack of suitable planning, interest, and public understanding, these problems have reached such proportions that nationwide attention is demanded and action for the development of adequate solutions must be taken.

Intensified action concerning these problems was made possible by the Solid Waste Disposal Act, Title II of Public Law 89-272, which was signed by the President on October 20, 1965. This legislation directs the Secretary of the Department of Health, Education, and Welfare to initiate, encourage, and support a national program aimed at discovering and evaluating better methods of coping with the solid waste problem.

The Secretary is authorized (1) to conduct and support research on the nature and scope of the problem, on methods of more safely and efficiently collecting and disposing of solid wastes, and on techniques for recovering from solid wastes potentially valuable materials and energy; (2) to provide training and financial and technical assistance to local and State agencies and other organizations in the planning, development, and conduct of solid waste management programs; (3) to encourage and support projects that may demonstrate new and improved methods of solid waste collection, handling, and disposal. The Bureau of Solid Waste Management carries out these responsibilities.

Among these responsibilities, the Bureau provides grant support for demonstrations relating to the development and application of new and improved methods of solid waste collection, storage, processing, and ultimate disposal; and grants for studies and investigations that may lead to a demonstration of improved disposal practices, or may provide solutions for regional or national solid waste disposal problems. Associated with this is the responsibility for collecting and making available by appropriate means the results of, and other information pertaining to, such federally supported demonstrations, studies and investigations.

Accordingly this report has been reproduced to disseminate as widely as possible the latest available information and findings of a project that has received grant support from the Bureau of Solid Waste Management. It is hoped that it will provide those working in this field with useful information that will be of assistance in developing approaches to the solutions of their solid waste disposal problems.

Three separate project reports appear in this publication: (1) interim report for 1967, covering the planning, design and construction phases of the project; (2) interim reports for January - April 1968, and for May - August 1968, which describe operating experiences and problems during what was basically the shakedown period of the plant, and also during the initial stages of full plant operation. Additional work is currently underway to complete the project. Additional progress reports will be made available by the Bureau of Solid Waste Management. The final report will be issued as a Public Health Service publication.

--RICHARD D. VAUGHAN, *Director*

Bureau of Solid Waste Management

ABSTRACT OF STUDY AND INVESTIGATION GRANT NO. D01-UI-00030

TITLE: Gainesville Compost Plant

GRANTEE: Gainesville Municipal Waste Conversion Authority
1600 S. E. 13th Road, P. O. Box 1152
Gainesville, Florida 32601

PROJECT DIRECTOR: Herbert W. Houston
Gainesville Municipal Waste Conversion Authority
1600 S. E. 13th Road, P. O. Box 1152
Gainesville, Florida 32601

PROJECT STARTED: June 1, 1966 PROJECT ENDS: February 28, 1969

OBJECTIVES: To demonstrate the reliability, suitability, economic feasibility, and sanitary and nuisance-free operation of a recently developed high-rate, mechanical composting system for the disposal of municipal refuse from a medium sized community.

PROCEDURES: A compost plant designed to process 20 tons of refuse per hour will be constructed to dispose of municipal refuse from the city of Gainesville, the University of Florida, and Alachua County. Facilities will be provided for incorporation of either raw or digested sewage sludge into the compost. The plant will utilize the Metropolitan Waste Conversion System previously used at Largo, Florida and currently in use at Houston, Texas.

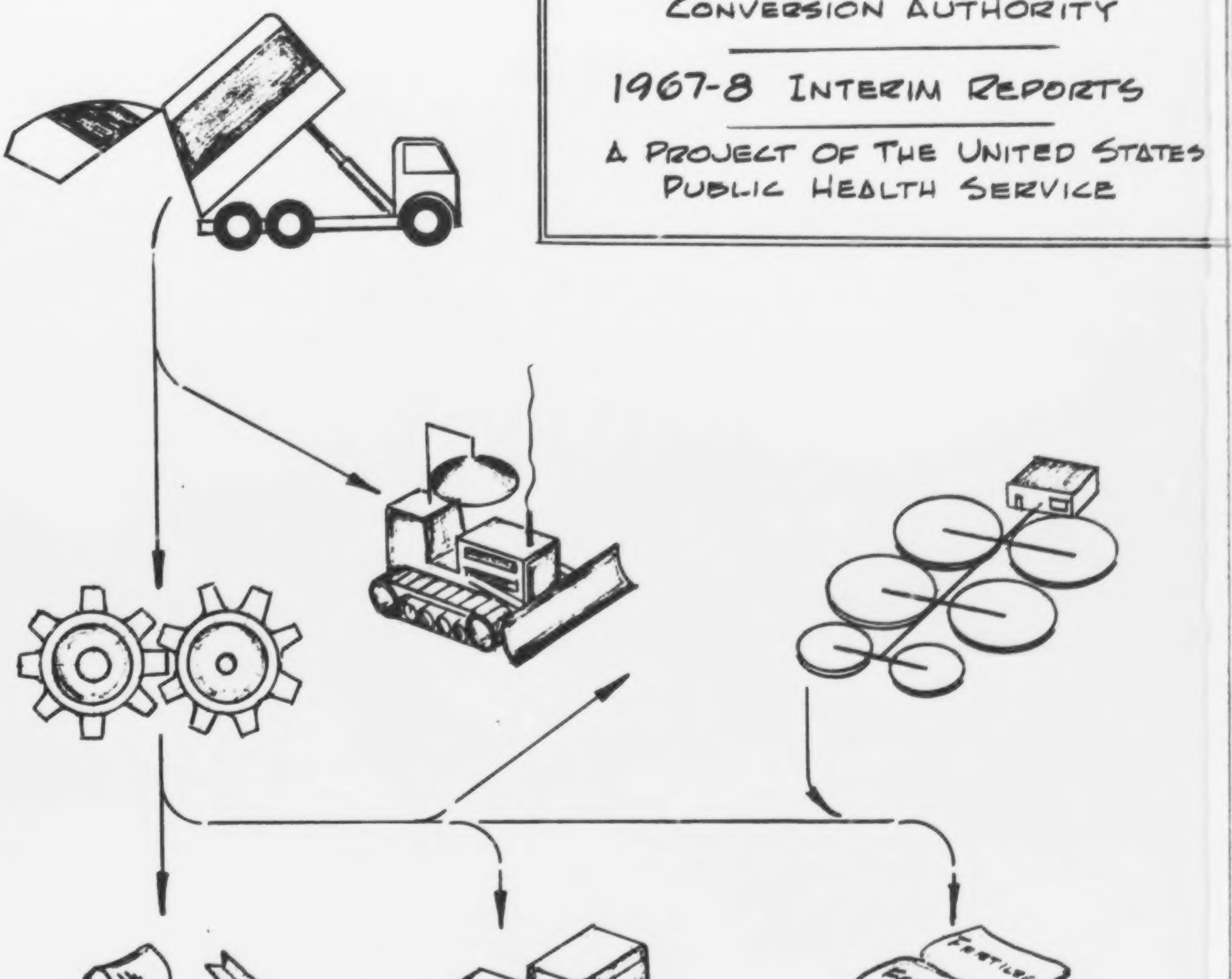
Records will be kept of the amounts of refuse and sludge processed, compost produced, salvaged materials and other noncompostable components. A complete cost analysis of the operation will be developed, including operation and maintenance costs of major items of equipment. The efficiency of the equipment will be evaluated, and operating characteristics and maintenance requirements determined. Necessary insect and rodent control measures will be instituted. Health records of employees will be maintained. Biological, bacteriological, and chemical and physical characteristics of the raw, partially digested, and finished compost will be determined.

Overall mechanical design criteria for the plant will be developed by the Metropolitan Waste Conversion Corporation, Wheaton, Illinois. Plant design and associated consulting engineering services will be provided by the firm of Reynolds, Smith and Hills, Jacksonville, Florida. Technical and scientific evaluation of the project will be planned and supervised by Environmental Engineering, Inc., Gainesville, Florida.

GAINESVILLE MUNICIPAL WASTE CONVERSION AUTHORITY

1967-8 INTERIM REPORTS

A PROJECT OF THE UNITED STATES
PUBLIC HEALTH SERVICE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1967 INTERIM REPORT

GAINESVILLE MUNICIPAL WASTE CONVERSION AUTHORITY, INC.

Re: DEMONSTRATION GRANT NO. 5-D01-UI-00030-02

GAINESVILLE COMPOST PLANT

Submitted to

SOLID WASTES PROGRAM
U. S. PUBLIC HEALTH SERVICE
DEPARTMENT OF HEALTH, EDUCATION & WELFARE

Composting Systems

GAINESVILLE MUNICIPAL WASTE
CONVERSION AUTHORITY, INC. • P.O. BOX 1152 • GAINESVILLE, FLORIDA 32601 • 904 • 372-4275

April 22, 1968

Mr. John A. Ruf, Project Officer
Demonstration Grants Activities
Solid Wastes Program
Dept. of Health, Education & Welfare
222 E. Central Parkway
Cincinnati, Ohio 45202

Re: 1967 Interim Report
Demonstration Grant No. 5-D01-UI-00030-02

Dear Mr. Ruf:

I am pleased to transmit to you herewith the 1967 Interim Report of the Gainesville Municipal Waste Conversion Authority, Inc.

This Report includes the period from the inception of the Project to the end of 1967, and covers the research, planning, design, financing, contracting and construction phases of the Project. While this part of the program is not as interesting or exciting as the operational phase which is now opening up, it is nevertheless highly important and, in fact, absolutely essential to a successful operating "demonstration".

In preparing this Report, we have generally followed the natural sequence of events during this period, taking up the various steps of the Program as each has come along. The main thrust during this period was to build and equip a solid waste disposal facility capable of achieving the objectives of the Project and, for that reason, almost two-thirds of the Report is used to describe in detail the Plant, the various components included in it, and the technical equipment, facilities and procedures provided for the evaluation and research phases of the Project.

Photographs and drawings have been used liberally through the Report, and it is hoped that these will facilitate a clear and easy understanding of the equipment and processes involved in the Metro-Waste Conversion System embodied in the Plant. A detailed Table of Contents and a complete Table of all Figures has been included, to facilitate easy reference. Certain material of a more technical and detailed nature has been included in Appendices A through D.

The officers and staff have worked very hard on this initial phase of the Project. We have spared no effort to make the Plant, and therefore the Project, as modern and up-to-date, as well planned and as well equipped as humanly

CABLE ADDRESS • METROWASTE

possible, and stay within the budgetary limits established. The Plant as now constructed has the most advanced design, is the most soundly constructed, and is the best equipped from the technical and control evaluation standpoint of any solid waste disposal facility in the world.

As we now look forward with confidence to entering vigorously into the operational phase of the Project, we feel that we have assembled a capable, dedicated employee group to staff the Plant; also, we feel that the Project is exceptionally fortunate in having very interested, highly qualified technical consultant personnel associated with us, in the Environmental Engineering group, and in the close, effective cooperative association with the University of Florida and its various key schools, which can make such an invaluable contribution to the success of a Project such as this.

Possibly it is trite to observe that Society's escalating solid waste discard problem, which contributes so substantially to environmental pollution, steadily worsens. We are pleased to know that your and our confidence in the potential in Metro-Waste's resource-recycling approach, as a significant step toward solving this dilemma, is being shared by a growing number of concerned public officials.

We also wish to express our appreciation to you and the others of the Solid Waste Program of the Public Health Service with whom our staff has worked so closely in bringing this major Project this far. Be assured that all of us at Gainesville are dedicated to bringing the Project to the very successful and significant conclusion originally envisioned.

Very truly yours,

GAINESVILLE MUNICIPAL WASTE
CONVERSION AUTHORITY, INC.

Victor Brown

Victor Brown, President

1967 INTERIM REPORT

GAINESVILLE MUNICIPAL WASTE CONVERSION AUTHORITY, INC.

TABLE OF CONTENTS

Item	Page
Letter of Transmittal	i
Key Project Personnel, Gainesville Municipal Waste Conversion Authority	omitted
Board of Trustees, Gainesville Municipal Waste Conversion Authority	omitted
Technical Consultant Personnel	omitted
Project Supervisory Personnel, Solid Waste Program United States Public Health Service	omitted
Table of Contents	vi
Table of Figures	xii
Appendices	xiv

I HISTORICAL BACKGROUND OF PROJECT

A. Solid Waste Disposal Act of 1965 1

B. Development of the Metro-Waste Conversion System 2

C. Interest of the University of Florida 2

D. Concept of the Project 3

II ORGANIZATION OF THE AUTHORITY

A. Charter and Authorized Purposes 4

B. Board of Trustees 5

C. Funding of Plant Construction Costs 5

D. Funding of Plant Operating Costs 5

E. Final Disposition of Plant 6

TABLE OF CONTENTS

Page

III DESIGN FACTORS OF THE PLANT

A. Basic Design Concept 6

B. Mechanical Design Criteria of the Plant 7

C. Technical and Scientific Design Criteria 8

D. Design Time Schedule 9

IV DETAILED DESCRIPTION OF PLANT

A. Site 9

B. Buildings 9

C. Receiving System 12

1. Truck Scale 12

2. Receiving Hopper 16

3. Apron Conveyor 19

4. Control Platform and Control Console 19

5. Oscillating Conveyor 21

6. Sorting Conveyor 22

7. Sorting Platform 22

D. Paper Salvage System 24

1. Collector Conveyor System 24

2. Baler 26

E. Grinding System 26

1. Crusher-Disintegrator 26

2. Ballistic Separator 28

3. Secondary Grinder 30

F. Sludge Handling System 31

1. Mixing Screws 31

2. Sludge Tank 32

3. Sludge Pump 36

4. Automatic Moisture Sensor 37

TABLE OF CONTENTS

	Page
5. Sludge Aerating System	37
6. Moist Refuse Conveyor	37
G. Digester System	38
1. Tripper Belt Conveyor	38
2. Tripper	38
3. Tripper Shuttle Conveyor	38
4. Digester Tanks	40
5. Air System	42
6. Agi-Loader	42
7. Transfer Car	45
H. Finishing System	45
1. Discharge Conveyor System	45
2. Final Grind Mills	47
3. Stockpiling	48
I. Metal Salvage System	49
1. Magnetic Separator	49
2. Metals Conveyor	49
3. Burner Conveyor	50
4. Burner	50
5. Exhaust Gas Scrubber System	52
6. Metal Pelletizer	54
7. Ferrous Metal Separator	56
8. Salvage Metals Storage Hoppers	56
J. Equipment Specification Table	58
V CONSTRUCTION OF PLANT AND COSTS	
A. Construction of Plant	58
B. Cost of Plant	59

TABLE OF CONTENTS

Page

VI OPERATIONAL PHASE OF PROJECT

A. Preliminary Equipment Testing 62

B. Start-up of Normal Operations 62

C. Personnel 62

D. Training of Personnel 62

E. Plant Management and Operations Procedures 64

F. Product Marketing 67

    1. Salvage Materials 67

    2. Compost Materials 70

VII TECHNICAL PROGRAM OF THE GAINESVILLE COMPOST PLANT

A. Facilities and Equipment 71

    1. Laboratory 71

    2. Process Control and Special Studies Equipment 72

    3. Moisture Sensor 72

    4. Temperature Sensor Probes 74

    5. Mobile Instrument Console 75

    6. Evaluation 77

B. Chemical Analyses 77

    1. Sampling Schedule 80

    2. Routine Analyses 80

    3. Periodic Analyses 80

C. Biological Studies 83

    1. Investigation Study Program 83

    2. Investigative Studies to Date 83

    3. Cooperative program with Johnson City Technical Group 88

    4. Arthropod and Rodent Control Program 88

    5. Occupational Health Program 94

    6. Testing Procedures Planned 95

TABLE OF CONTENTS Page

D. Special Studies 96
  1. Compost Stabilization Parameter 99
  2. Study Effects of Enrichment 99
  3. Sewage Sludge Studies 99
  4. Other Special Studies 101

VIII UNIVERSITY RELATED PROJECTS
A. Solid Waste Teaching Grant 101
B. Micology Study Grant 102
C. Analysis Study of Digester Tanks 103
D. Analysis of Compost Usage on Soil Structure and Crop Production 103
E. Integration with Teaching Programs 103
F. Pathogen Survival Research Grant 103
G. Laboratory and Class-Conference Room 103
H. Future Special Courses 104

IX RELATIONSHIPS WITH PUBLIC HEALTH AUTHORITIES 104
A. Alachua County Health Department 104
B. Florida State Board of Health 105
  1. Approval of Plans 105
  2. Inspection 105
  3. Conditions Imposed by State Board of Health 106
    a. Use of Sludge 106
    b. Air Pollution 106
    c. Use of Compost 106
C. U. S. Public Health Service 107

X SUMMARY AND CONCLUSIONS 108
A. Construction Phase 108

TABLE OF CONTENTS

Page

B. Observations during Construction 108

1. Weather 109

2. Labor Relations 109

3. Design Changes 109

C. Specific Design Changes made during the Year 110

1. Receiving Ramp 110

2. Receiving Hopper 110

3. Receiving Area 110

4. Primary Grinder 110

5. Digesters 110

6. Storage Area 110

7. Bulk Storage Building 110

8. Dryer 110

9. Scrubber 111

10. Salvage Metal Mill 111

D. Conclusion 111

TABLE OF FIGURES

Figure Number	Type	Item	Page
1	Drwg	Vicinity Map and Site Plan	10
2	Photo	Office and Laboratory Building	11
3	Photo	Main Plant and Office Building	12
4	Drwg	Office Floor Plan	13
5	Drwg	Plant Floor Plan	14
5-A	Drwg	Flow Diagram	15
6	Photo	Scale Control System	17
7	Photo	Receiving Building and Ramp	17
8	Drwg	Receiving Hopper with Apron Conveyor	18
9	Drwg	Control Platform with Console	20
10	Photo	Control Console	21
11	Drwg	Sorting Platform	23
12	Photo	Sorting Platform, Centriblast Grinder, and Ballistic Separator	24
13	Photo	Paper Baler and Collector-Conveyor System	25
14	Photo	Crusher-Disintegrator	27
15	Photo	Ballistic Separator	28
16	Photo	Secondary Grinder	31
17	Photo	Sludge Storage Tank, Sludge Pump and Sludge Aeration Blower	33
18	Photo	Sludge Mixing Screws Underneath Secondary Grinder	33
19	Drwg	Sludge Storage Tank	34
20	Drwg	Sludge Handling System	35
21	Photo	Tripper Belt Conveyor	36
22	Photo	Tripper and Shuttle Conveyor	39
23	Photo	Digester Tank and Agi-Loader	40
24	Drwg	Digester Tank with Air System	41

TABLE OF FIGURES

Figure Number	Type	Item	Page
25	Photo	Agi-Loader	44
26	Photo	Final Grind Mills	46
27	Photo	Delivery Conveyor from Secondary Grinder to Magnetic Separator	47
28	Photo	Electro-Magnetic Separator	48
29	Photo	Bulk Storage Building and Conveyor	48
30	Drwg	Burner	51
31	Drwg	Exhaust Gas Scrubber	53
32	Photo	Burner, Pelletizer and Metal Storage Hoppers	55
33	Drwg	Salvage Metals Storage Hoppers	57
34	Table	Table of Organization, Plant Personnel	63
35	Chart	Inspection and Lubrication Schedule	65
36	Chart	Evaluation Control Report, Equipment Repair and Maintenance Costs	66
37	Chart	Monthly Operations Expense Analysis Report (1st page)	68
37A	Chart	Monthly Operations Expense Analysis Report (Summary Page)	69
38	Drwg	Laboratory Floor Plan	73
39	Photo	Moisture Sensing Electrodes	74
40	Drwg	Mobile Instrument Console	76
41	Chart	Operating, Analyzing and Recording Sequence 20-Point Strip Chart Recorder B	78
42	Drwg	Schematic Flow Diagram, Mobile Instrument Console	79
43	Table	Chemical Analyses Sampling and Analysis Procedures	81
44	Table	Coliform Determinations in Compost and Soil Conditioners	85
45	Table	Table of Distribution of Coliforms in Compost	89

TABLE OF FIGURES

Figure Number	Type	Item	Page
46	Table	Table of Salmonella Presumptives in Ground Refuse	90
47	Table	Screening Method for Salmonella Detection	91
48	Table	Rodent and Roach Bait and Spray	93
49	Table	Microbiological Sampling and Testing Schedule	97
50	Table	Flow Sheet for Coliform Determination	98

APPENDICES

Appendix	Item	Page
A	Machine and Equipment Specification Table	112
B	Personnel Chart, Plant Personnel	117
C	Table of Major Laboratory Equipment	118
D	Table of Process Instrumentation Systems Components	119
E	Chapter 170 C-10.09, Florida Administrative Code	120

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1967 INTERIM REPORT

GAINESVILLE MUNICIPAL WASTE CONVERSION AUTHORITY, INC.

To: U. S. Public Health Service

Re: Demonstration Grant No. 5-D01-UI-00030-02

The following Annual Report for activities of the Gainesville Municipal Waste Conversion Authority, Inc., a non-profit corporation organized under the laws of the State of Florida, concerning activities of the Authority under Solid Waste Grant No. 5-D01-UI-00030-02, for the year 1967, is hereby respectfully submitted. For the reason that the initial phases of planning the project and designing and constructing the plant have covered two project years, and are substantially completed with the close of the current year, this report is made as a comprehensive report covering the entire pre-operation phases of the project.

I HISTORICAL BACKGROUND OF PROJECT

A. Solid Waste Disposal Act of 1965. In the fall of 1965 Congress enacted the Solid Waste Disposal Act of 1965. This act is a broad attack on all phases of the solid waste disposal problem threatening to engulf the country, and a significant part of the Act is the demonstration grant program, sub-Section (b)(3) of Section 204, under which this project was authorized, and which reads as follows:

> "(b) In carrying out the provisions of the preceding sub-section, the Secretary is authorized to - - - - "
>
> "(3) make grants-in-aid to - - - - - agencies and institutions and to individuals for research, training projects, surveys, and demonstrations (including construction of facilities), and provide for the conduct of research, training, surveys, and demonstrations by contract with public - - - - agencies and institutions and with individuals; - - - -"

B. Development of the Metro-Waste Conversion System. The Metro-Waste Conversion System was developed as a new approach to the solid waste disposal problem, treating solid waste as a natural resource, or a raw material, and was aimed at the conversion of this avalanche of raw material into whatever useful forms could be developed, and re-cycling this "converted" refuse back into useful channels of commerce, agriculture and trade. The objective of the system is the conservation and conversion of a useless, troublesome material into a constructive and useful form, rather than destruction, and to accomplish this in a nuisance-free, pollution-free, economic manner.

The system was developed first in a pilot plant at Largo, Florida, having a daily capacity of about 40 tons per day, and was carried to successful commercial application at Houston, Texas, where a plant of 360 tons per day input capacity was placed in operation in January of 1967, and has been in satisfactory, continuous operation since opening.

C. Interest of the University of Florida. The Environmental Engineering Department of the University of Florida has long been aware of the problems existing in the field of solid waste disposal in the United States, and has been interested in the Largo pilot plant of the Metro-Waste System since 1964, when that plant became a regular "field trip" project for environmental engineering students. The Engineering Department regarded the demonstrated capability of the Metro-Waste System to dispose of both solid waste and the solids in sewage waste in one compatible aerobic microbial digesting operation as a major breakthrough in the entire field of disposal of municipal wastes on a sanitary, non-offensive and constructive basis, and felt that the system deserved careful study for use in medium and large-sized municipalities throughout America. University personnel recognize that the Solid Waste Disposal Act of 1965 represented an unusual opportunity for a demonstration solid waste facility to be located in the City of Gainesville, Florida, to serve all three of the important demonstration grant objectives contemplated in Section 202(b)(3) of the Act, namely (1) demonstrate an effective commercial solid waste disposal process of an intermediate size (to serve the solid waste disposal needs of the City, the University and the County); (2) provide an important research facility; and (3) provide a very useful teaching and training facility.

After careful discussions involving Metropolitan and the three Public Participants (the City of Gainesville, the University of Florida, and Alachua County), and consultations of Mr. Ralph Black, now Deputy Chief, Solid Waste Program, U.S. Public Health Service, with University and City officials, the Public Participants and Metropolitan all agreed to the formation of the Gainesville Municipal Waste Conversion Authority to apply for a demonstration grant. The application was prepared and filed in April of 1966.

D. Concept of the Project. The Project as developed in the application to the Public Health Service had as its primary objective the demonstration of the reliability, suitability, sanitation and economic feasibility of a recently-developed high-rate mechanical compost system of disposal of municipal refuse and trash for medium-sized communities of the Metro-Waste type. This would be accomplished by receiving and processing of all of the domestic and commercial refuse generated in the City of Gainesville, the University of Florida and adjacent populated areas of Alachua County. The Project was planned to continue for a demonstration period of possibly seven years. Additional objectives of the project were specified in the application as follows:

1. Demonstration of effective health and sanitation practices suitable for municipal composting operations.
2. Demonstration of safe, nuisance-free operation of a compost disposal facility.

3. Demonstration of the effectiveness, efficiency, economy, maintenance and effective life of equipment utilized in the Metropolitan composting system.
4. Demonstration of the ability of a mechanical composting plant to assimilate large proportions of raw sewage solids into the ground refuse, composting the entire mass. The success of this effort can reduce a city's sewage treatment cost substantially while enriching the compost produced.
5. Provide an effective teaching and research facility for the use of the University in studying municipal solid waste disposal methods, techniques, equipment controls, etc.
6. Cooperation with Agriculture Experiment Station of the University, to demonstrate the benefits of use of the compost end-product over a sustained period of years. These benefits are improvement in soil condition and structure, improvements in health and productivity of trees, crops, shrubs and other plants grown thereon, reduced water and fertilizer requirements, over-all health improvement, and various other benefits. (The Agricultural Experiment Station of the University has a separate grant from the National Institutes of Health to carry on a 5-year compost research program, utilizing compost provided free by the Authority).

II ORGANIZATION OF THE AUTHORITY

A. Charter and Authorized Purposes. Prior to the filing of the grant application, the Gainesville Municipal Waste Conversion Authority was organized on April 19, 1966, under a not-for-profit certificate of incorporation issued by the Secretary of State of Florida. Purposes of the Authority as set forth in its Certificate of Incorporation include the disposal of garbage, trash and sewage wastes generated in the City of Gainesville, other communities, and educational and other public institutions, and to pursue a program of continuing testing, experimenting and study to develop the most efficient, sanitary and nuisance-free methods, processes, equipment, procedures and techniques to accomplish effective, sanitary composting processes of municipal waste and producing a compost end product of maximum benefit and value for agricultural and horticultural uses and applications; also, to carry on testing, experimenting and study programs to demonstrate effective and satisfactory methods, standards and principles for efficient operation of compost plants.

B. Board of Trustees. The Authority is governed by a board of seven trustees. Three of the trustees are designated, one-each by each of the three Public Participants in the program, the City of Gainesville, the University of Florida, and Alachua County. A fourth trustee is designated by the first three trustees representing the Public Participants. The remaining three trustees are designated by Metropolitan Waste Conversion Corporation.

C. Funding of Plant Construction Costs. Financing of the plant has been provided 2/3rds under the grant approved by the Public Health Service and 1/3rd by issuance of $530,000.00 in 6½% First Mortgage Revenue Bonds of the Authority, the sale of which has been arranged by Metropolitan, through Francis I. duPont and Company, a leading U.S. securities firm. The bonds mature at the rate of $25,000.00 per year from 1970 through 1990.

Interest on the bonds and re-payment of the principal of said bonds will be provided from the sale of the compost product and salvage materials generated by the plant, the sale of which has also been arranged by Metropolitan to assure matching funds being available. It is planned that these materials generated at the plant will be recycled in bulk into normal commercial raw material channels, as follows:

1. Salvage paper: To the secondary fiber materials industry in the Jacksonville area.
2. Salvage metals: To the foundry and steel industries in the Tampa-Jacksonville-Birmingham areas.
3. Compost: Some sales will be directly in basic form to the local retail bulk and bag market. The largest part of product is expected to be sold to the fertilizer, agricultural and commercial trade as a raw material for blending, finishing and enriching, and for granulating for the agriculture, horticulture, hydro-mulch and consumer trade industries.

D. Funding of Plant Operating Costs. Plant operating costs for the duration of the Project Period are to be provided 2/3rds by a grant from the U.S. Public

Health Service and 1/3rd proportionately from the three participating public bodies. The non-grant portion of operating costs has been allocated among the three Public Participants for the first year by mutual agreement as follows:

Non-grant operating funds:	
City of Gainesville	27,500
University of Florida	22,500
Alachua County	22,500
Total by public participants	72,500
Grant share of operating funds:	
U.S. Public Health Service	145,000
Total projected 1st-year operating costs	217,500

For subsequent years of the grant period the non-grant portion of operating cost is to be allocated among the three local public participants generally in proportion to the weight of refuse delivered by each, with the exact allocations to be mutually agreed upon year by year.

E. Final Dispostion of Plant. Upon termination of the project and payment in full of the bonds issued by the Authority, title to the plant will pass from the Authority to the City of Gainesville.

III DESIGN FACTORS OF THE PLANT

A. Basic Design Concept. The plant has been modeled on the basic Metro-Waste compost design, as developed and perfected at the Largo plant of Metropolitan, and embodied in major commercial form in its Houston plant, which was well under construction at the time of grant award. This is basically a batch-type, high-rate mechanical aerobic bacterial digestion system. The system is designed to accept all refuse normally collected in city refuse collection vehicles, to remove as much salvage material as can be processed efficiently and economically, to remove non-compostable materials, and then to grind, moisten and digest the remaining materials into a stable, nuisance-free material beneficial to the soil. The objective has been to provide physical conditions for optimum bacterial growth (temperature, moisture, oxygen and food supply), and to provide a modern, efficient material handling process.

B. Mechanical Design Criteria of the Plant. The overall mechanical design criteria of the plant were developed by the Metropolitan organization based upon its three years of intensive study, research, experimentation and development in the field of high-rate, mechanical composting. The mechanical design criteria are directed toward the accomplishment of a two-fold objective:

1. The removal and processing for reuse of salvageable materials (paper, metals, textiles and glass) in the most economic and nuisance-free manner possible.

2. Processing the non-salvageable organic wastes by proper grinding, moistening, and aerobic bacterial digestion in a nuisance-free and economical manner, to a stable, humus-like, organic soil-conditioning material.

Based on these objections, mechanical design criteria were adopted as follows:

1. Overall capacity: 150 tons per day.
2. Operating capacity: 20 tons per hour.
3. Paper extraction: hand and mechanically sorted and mechanically baled.
4. Metal extraction: combination of hand sort, ballistic and electromagnetic separation.
5. Digester particle size: approximate one inch x one inch.
6. Moisture control: electronic sensing and pump control.

7. Digestion period: six days.
8. Digester agitation schedule: variable, one to three times during digestion.
9. Digester aeration schedule: complete flexibility as to length of cycle and duration of aeration per cycle.
10. Digestion temperature and gas content: measuring and recording equipment adequate for evaluation, processing and research purposes.
11. Final grind particle size: typical size ¼", adequate for both application in basic "raw" condition and for further processing in blending, enriching and granulating processes.
12. Curing period: 8 weeks or longer.

Selection of equipment to meet mechanical design criteria relating to capacity, processes, sizing, material handling and technical controls was the responsibility of Metropolitan. Based upon these design criteria, the detailed design work and engineering was carried out by the engineering firm of Reynolds, Smith and Hills of Jacksonville, the engineering firm retained by Metropolitan for this same responsibility in Houston.

C. Technical and Scientific Design Criteria. The planning for technical and scientific aspects of the Project, including microbiology, bacteriology, chemistry, air pollution and other technical aspects and including both the procedures and the equipment involved, have been planned and will be supervised by Environmental Engineering, Inc., a consulting engineering firm of Gainesville, specializing in all phases of engineering pertaining to enrivonmental matters.

D. Design Time Schedule. Approximately eight months were required from the time of notice of the grant award for completing the organization of the Authority, selecting a project director, completing the financing of the non-grant portion of the cost of the plant, completing the detailed designing of the plant, taking construction bids, and the letting of contracts. Construction was begun about March 1, 1967. Approximately 12 months were anticipated for construction, shakedown and testing of the plant. While the plant was still in the course of design, Metropolitan completed the construction of its Houston plant and placed this plant in regular commercial operation. After observing this plant in operation, considerable important information was developed from actual experience and observation and, where the plant layout and detailed design of the Gainesville project could benefit, advantage of this additional experience and knowledge was taken.

IV DETAILED DESCRIPTION OF PLANT

A. Site. The plant is located on a 5-acre tract of land provided by the City of Gainesville. This tract is a part of the sewage treatment plant site of the City, and is located immediately across a small stream from the sewage treatment plant itself. A substantial expansion of the sewage treatment plant is now being carried on, following which a sludge line will be constructed from the sewage treatment plant for pumping thickened sludge to the compost plant for disposal in the composting process. (See Vicinity Map and Site Plan, Figure 1, Page 10.)

B. Buildings. The plant consists of three separate buildings. A small building, 72 ft. x 32 ft., houses the office, the control laboratory, the research laboratory, and a general-purpose classroom-conference-meeting room. (See Figure 2, Page 11.)

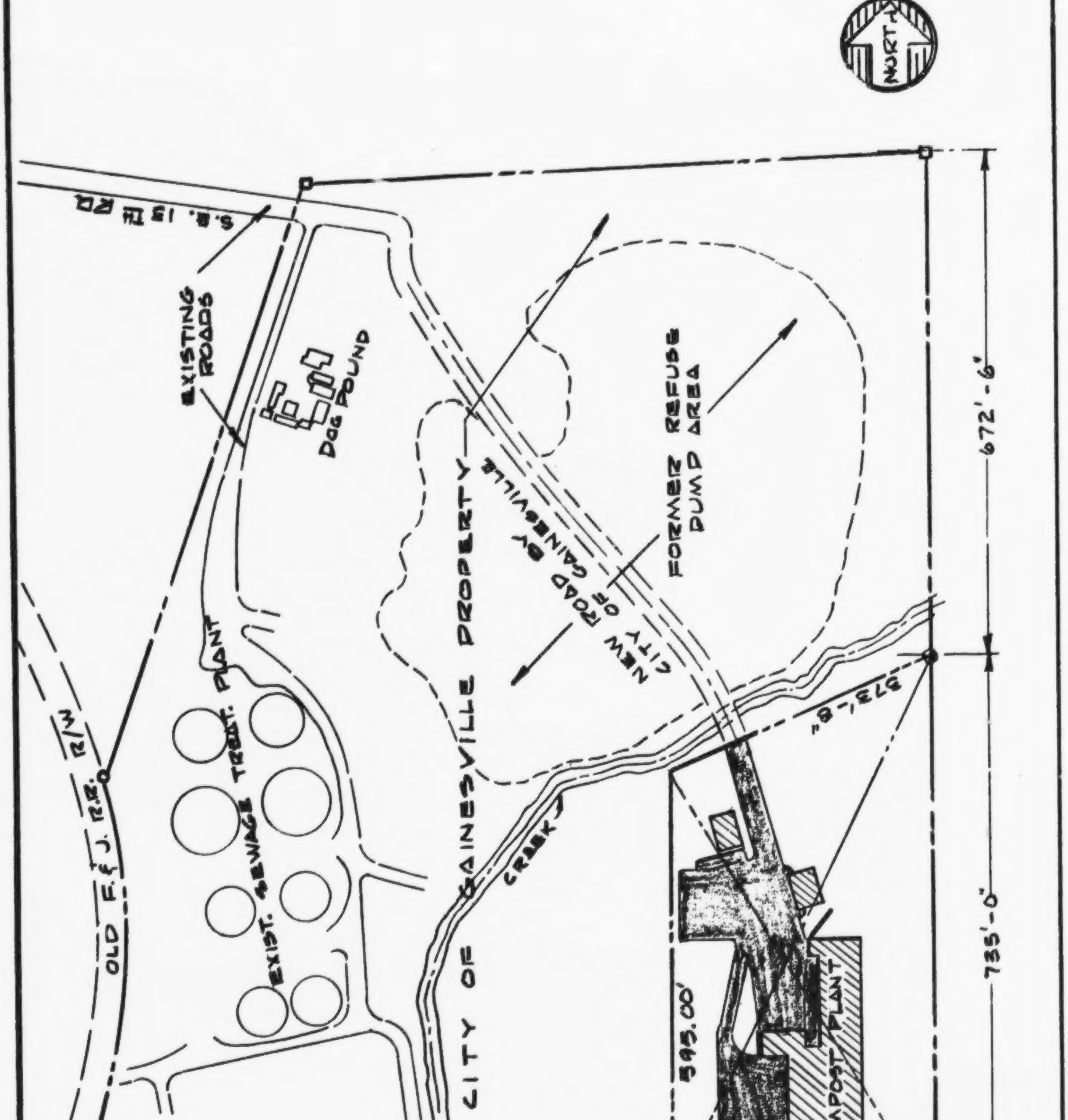

NORTH
S.E. 13TH RD
EXISTING ROADS
DOG POUND
FORMER REFUSE DUMP AREA
NEW ROAD BY CITY OF GAINESVILLE
CITY OF GAINESVILLE PROPERTY
CREEK
EXIST. SEWAGE TREAT. PLANT
OLD F.&J. R.R. R/W
COMPOST PLANT
672'-6"
735'-0"
350'-0"
373'-8"
393.00'

FIG. 1

VICINITY MAP
SCALE = 1" = 200'

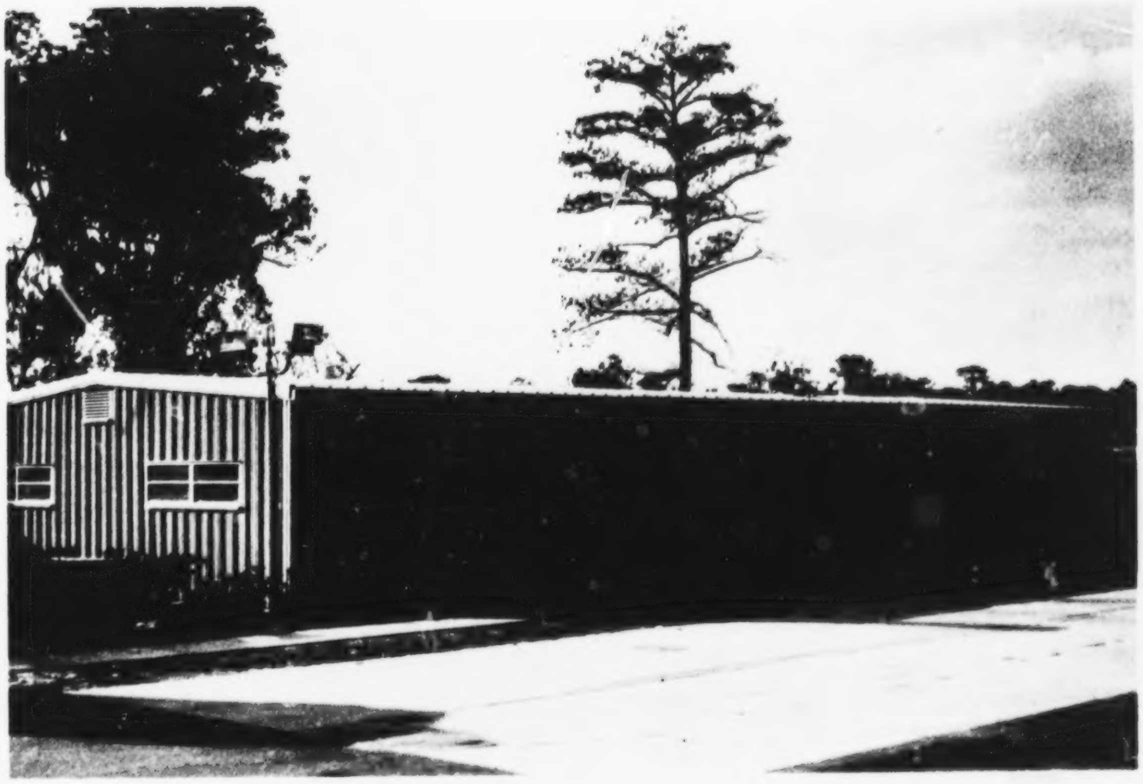


Figure 2. Office, Laboratory and Conference Room Building

The main plant building, about 30,000 square feet, contains all of the operating phases of the plant, including the receiving, processing, digesting and final grinding of the composted refuse. (See Figure 3, Main Plant and Office Buildings, Page 12.) The Bulk Storage Building is 90 feet long by 76 feet wide by 20 feet high, with a sloping shed roof. This building covers the compost truck loading area, and also an area where some compost can be stockpiled for curing, and where some finished compost can be stored.

All buildings are essentially standard, industrial-type steel buildings. The office-lab building has an attractive masonry front. The layout and dimensions of the office building are shown on Figure 4, Office Floor Plan, Page 13 following, and the dimensions and layout of the main plant building are shown in Figure 5, Page 14 following.

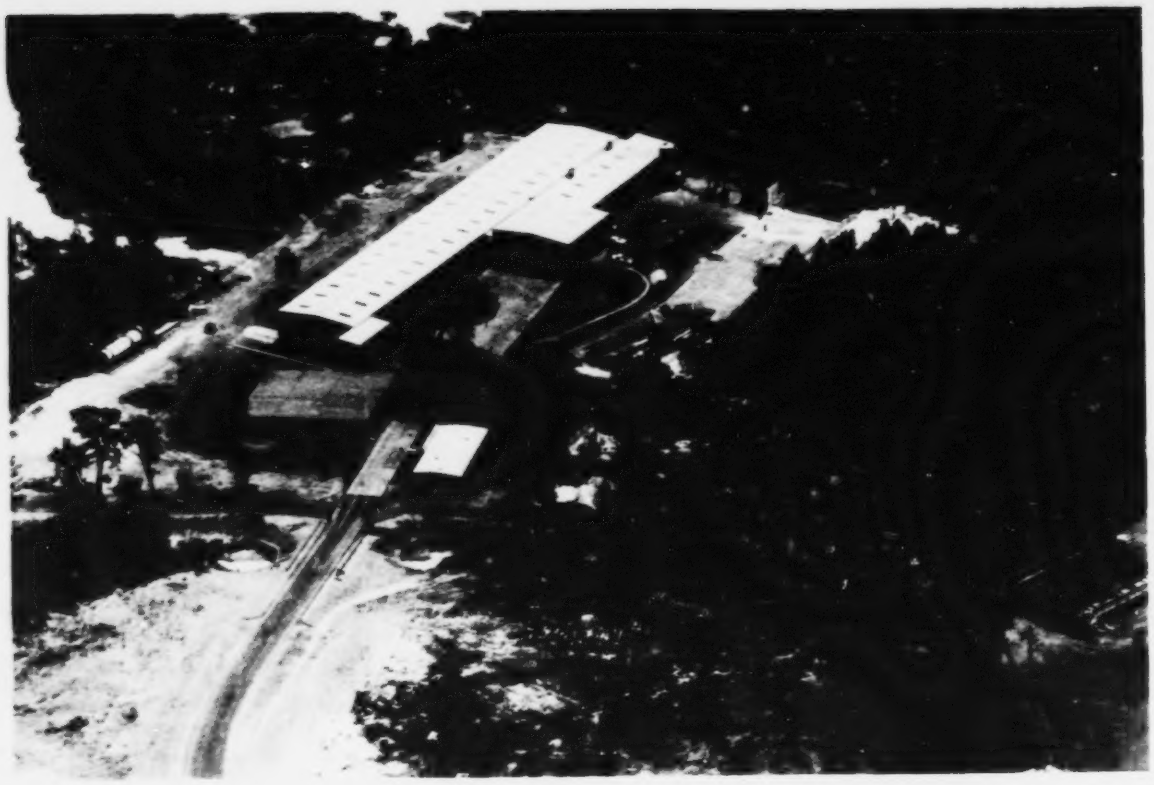


Figure 3 Main Plant and Office Buildings

The flow of material through the Plant, including all the various handling and processing systems, is shown on Flow Diagram (Figure 5 A, Page 15 following.)

C. Receiving System.

1. Truck Scale. The first operation as the trucks arrive at the compost plant is the weighing operation. This utilizes a Toledo Model 2781 motor truck scale, 50-ton capacity, 60' x 10' platform, supplied with the following additional equipment:

a. Electronic dial and printweight with nine banks of selective numbering devices.

b. Card reader to receive pre-punched plastic truck identification

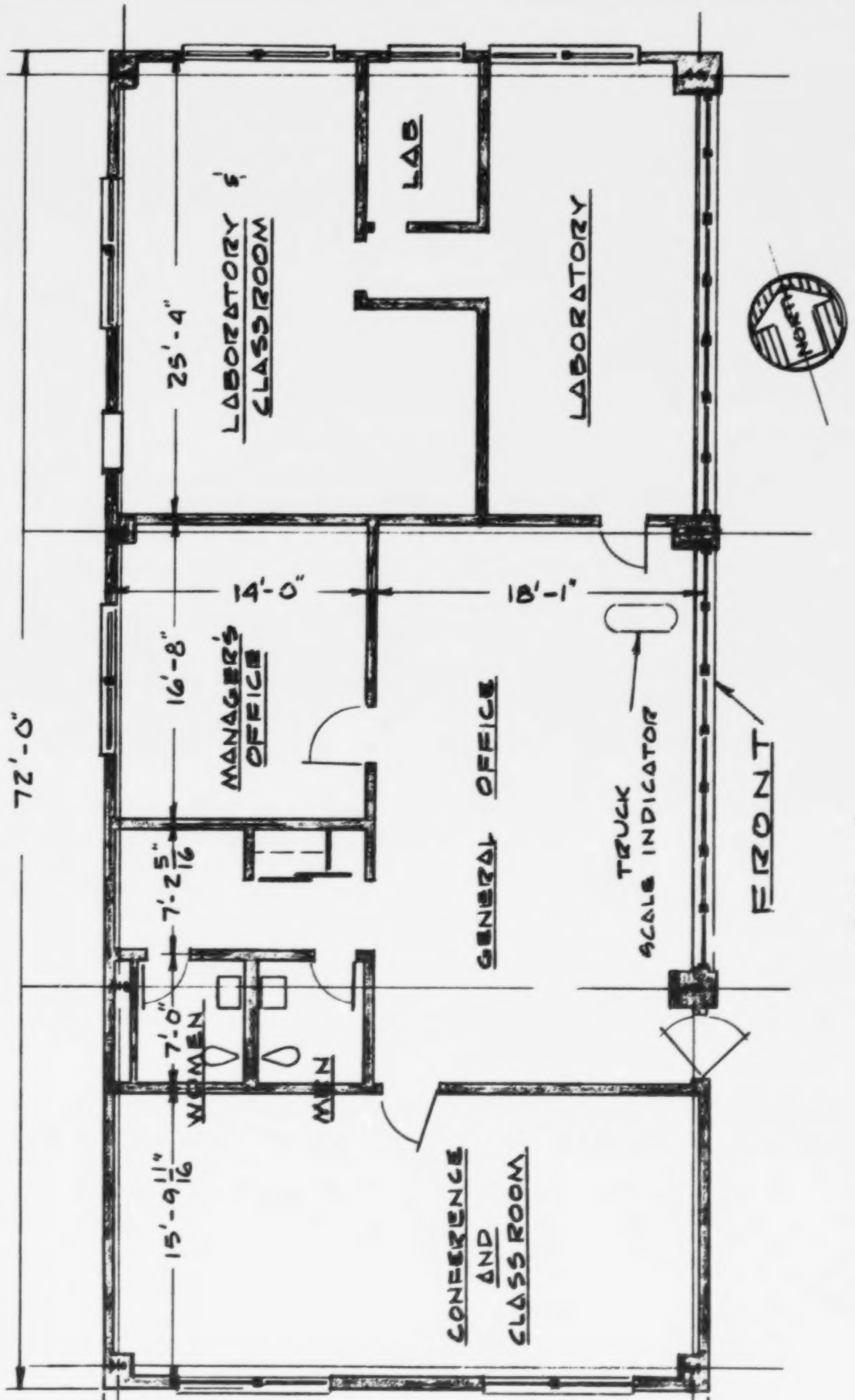
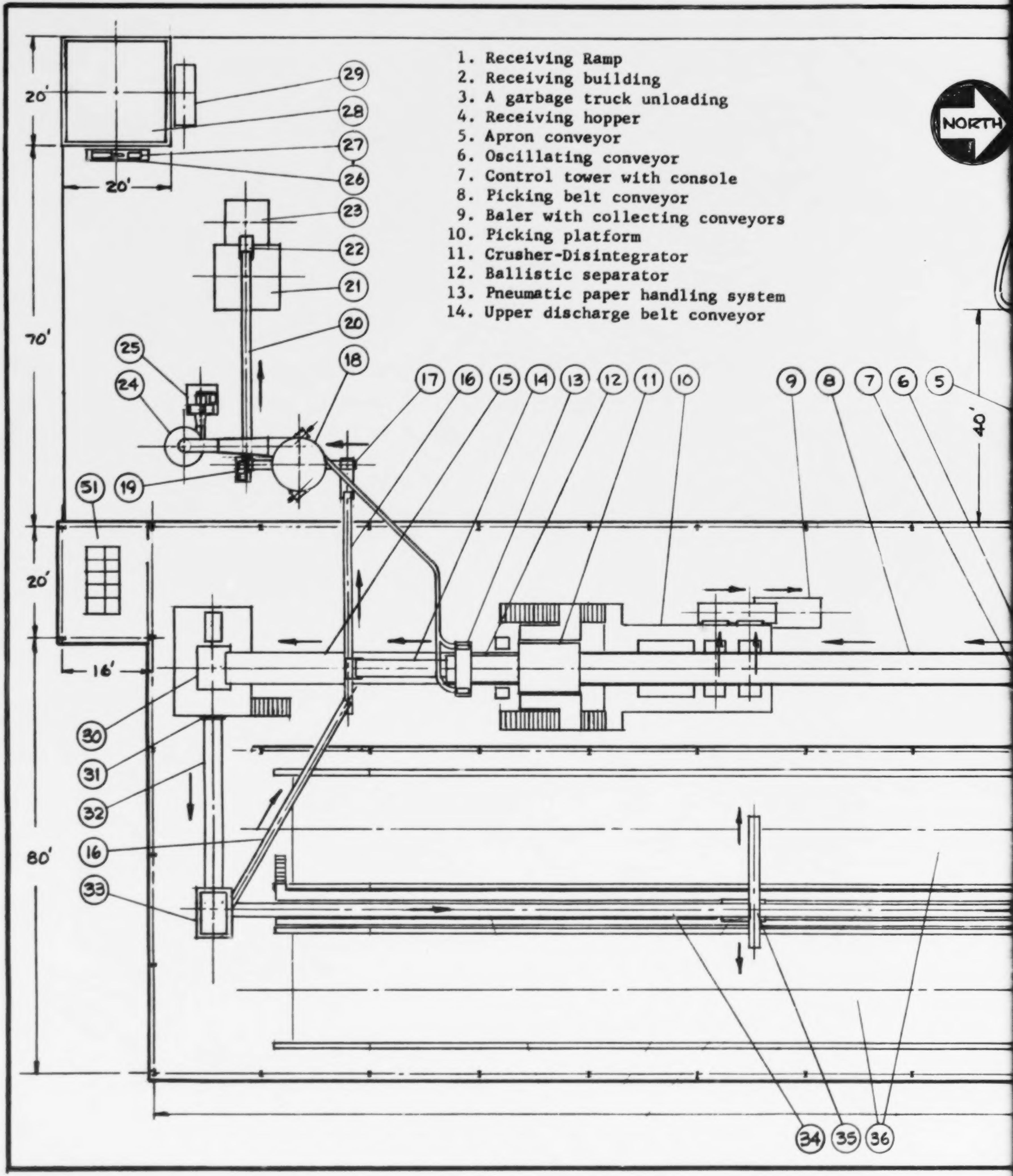

72'-0"
25'-4"
LABORATORY &
CLASSROOM
LAB
LABORATORY
NORTH
14'-0"
18'-1"
16'-8"
MANAGER'S
OFFICE
GENERAL OFFICE
TRUCK
SCALE INDICATOR
FRONT
7'-2 5/16"
7'-0"
WOMEN
MEN
15'-9 11/16"
CONFERENCE
AND
CLASSROOM
32'-2 1/2"

FIG. 4

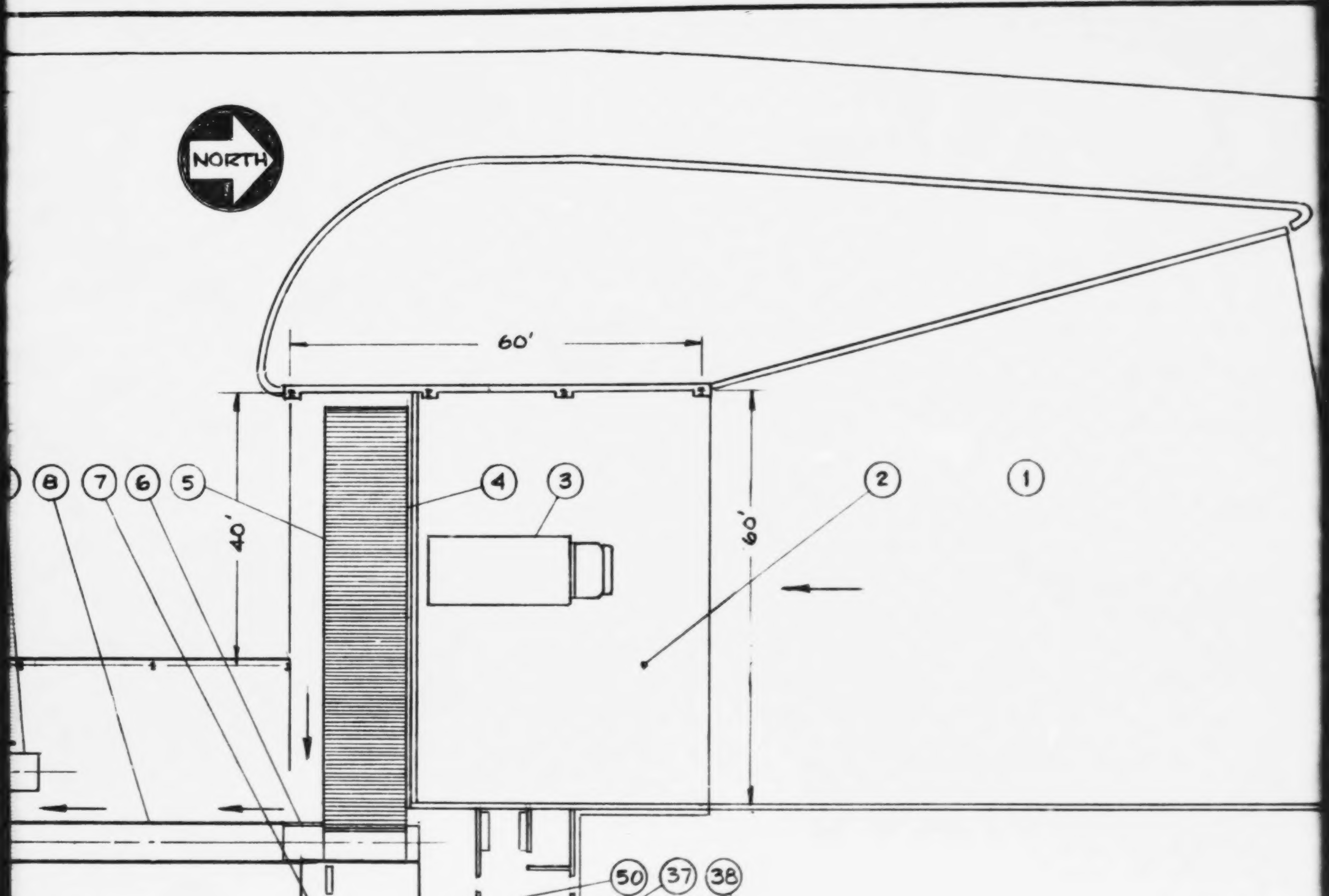
OFFICE FLOOR PLAN



1. Receiving Ramp
2. Receiving building
3. A garbage truck unloading
4. Receiving hopper
5. Apron conveyor
6. Oscillating conveyor
7. Control tower with console
8. Picking belt conveyor
9. Baler with collecting conveyors
10. Picking platform
11. Crusher-Disintegrator
12. Ballistic separator
13. Pneumatic paper handling system
14. Upper discharge belt conveyor

NORTH
20'
20'
70'
20'
16'
80'
40'
29
28
27
26
23
22
21
20
25
24
18
19
51
17
16
15
14
13
12
11
10
9
8
7
6
5
30
31
32
16
33
34
35
36

A


NORTH
60'
40'
60'
8
7
6
5
4
3
2
1
50
37
38
380'
35
36
37

B

15. Lower discharge belt conveyor
16. Can Conveyor
17. Woven metal belt
18. Burner
19. Metal pelletizer
20. Metal pellet conveyor
21. Ferrous metal hopper
22. Magnetic separator
23. Non-ferrous metal
24. Air heater exhaust scrubber
25. Scrubber exhaust blower
26. Sludge pump
27. Sludge aeration blower
28. Sludge tank
29. Diesel oil storage tank
30. Secondary grinder
31. Sludge mixing screws
32. Cross conveyor
33. Magnetic separator
34. Tripper unloading belt
35. Tripper with unloading shuttle conveyor
36. Digesters
37. Digester aeration blowers
38. Agiloader w/unloading shuttle conveyor
39. Agiloader transfer car rails
40. Digester unloading conveyor
41. Agiloader transfer car
42. Regrind loading conveyor
43. Regrind distributing screw conveyor
44. Regrind mill feeder screw conveyors (2)
45. Regrind mills (2)
46. Regrind overflow screw conveyor
47. Regrind discharge screw conveyor
48. Stockpiling belt conveyor
49. Storage building w/truck loading ramp
50. Lavatory and showers
51. Electrical switchgear room

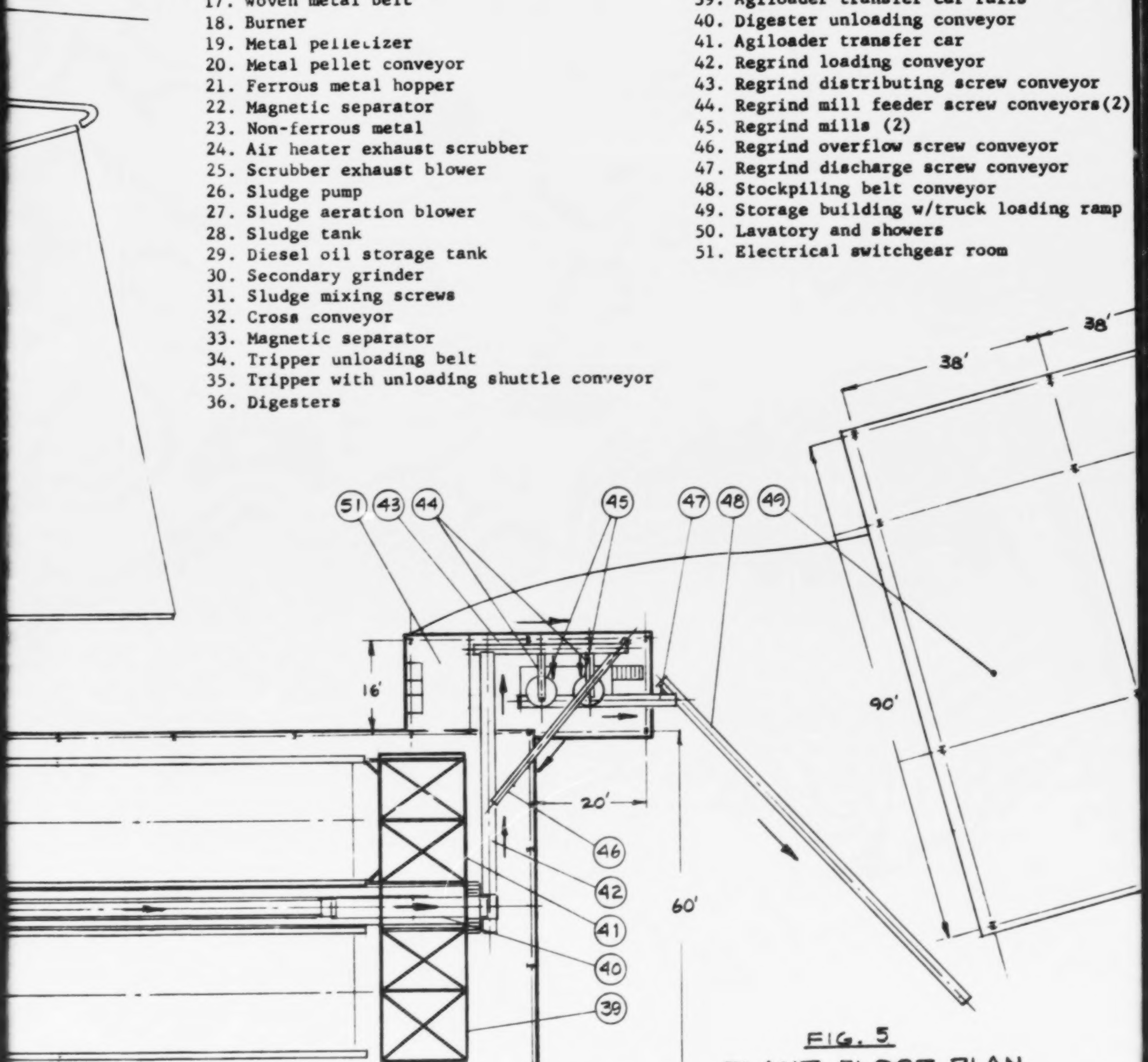
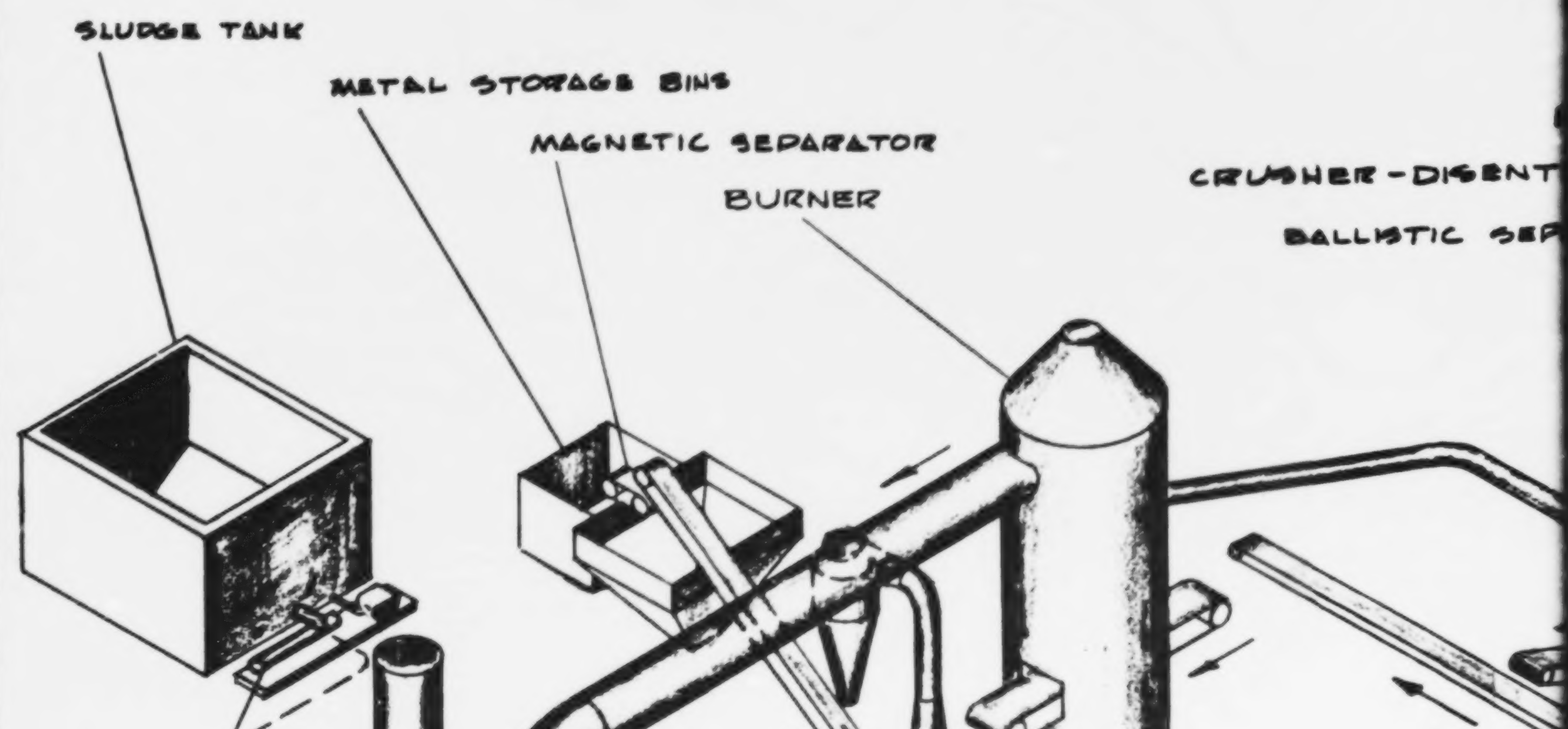
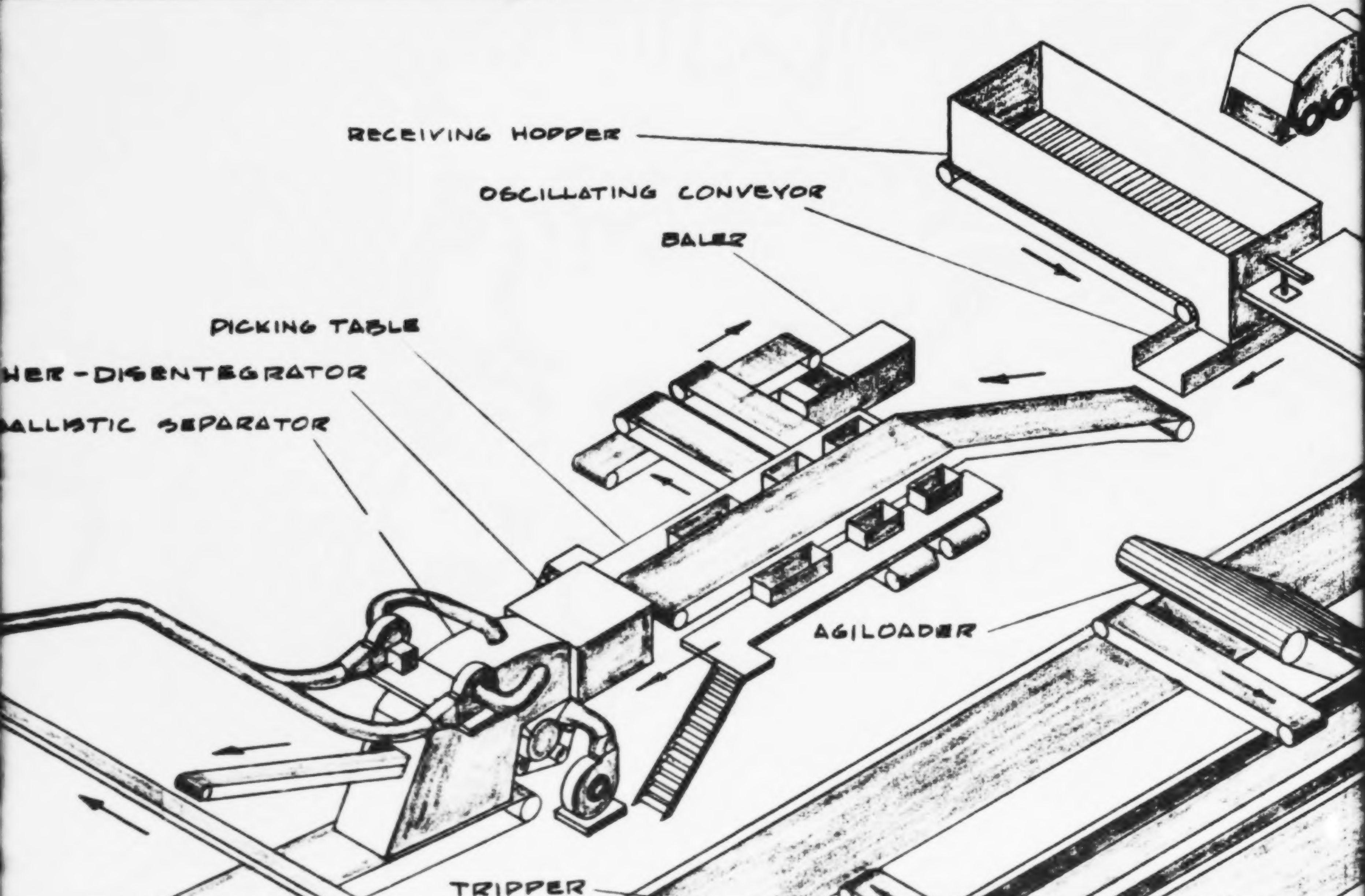


FIG. 5
PLANT FLOOR PLAN

C


SLUDGE TANK
METAL STORAGE BINS
MAGNETIC SEPARATOR
BURNER
CRUSHER-DISENT
BALLISTIC SEP
SLUDGE PUMP
METAL PELLETIZER
EXHAUST FAN
MAGNETIC SE
SECONDARY GRINDER
WET SCRUBBER
MIXING SCREWS

H


RECEIVING HOPPER
OSCILLATING CONVEYOR
BALER
PICKING TABLE
HER - DISENTEGRATOR
ALLISTIC SEPARATOR
AGILOADER
TRIPPER
MAGNETIC SEPARATOR
DIGEST

B

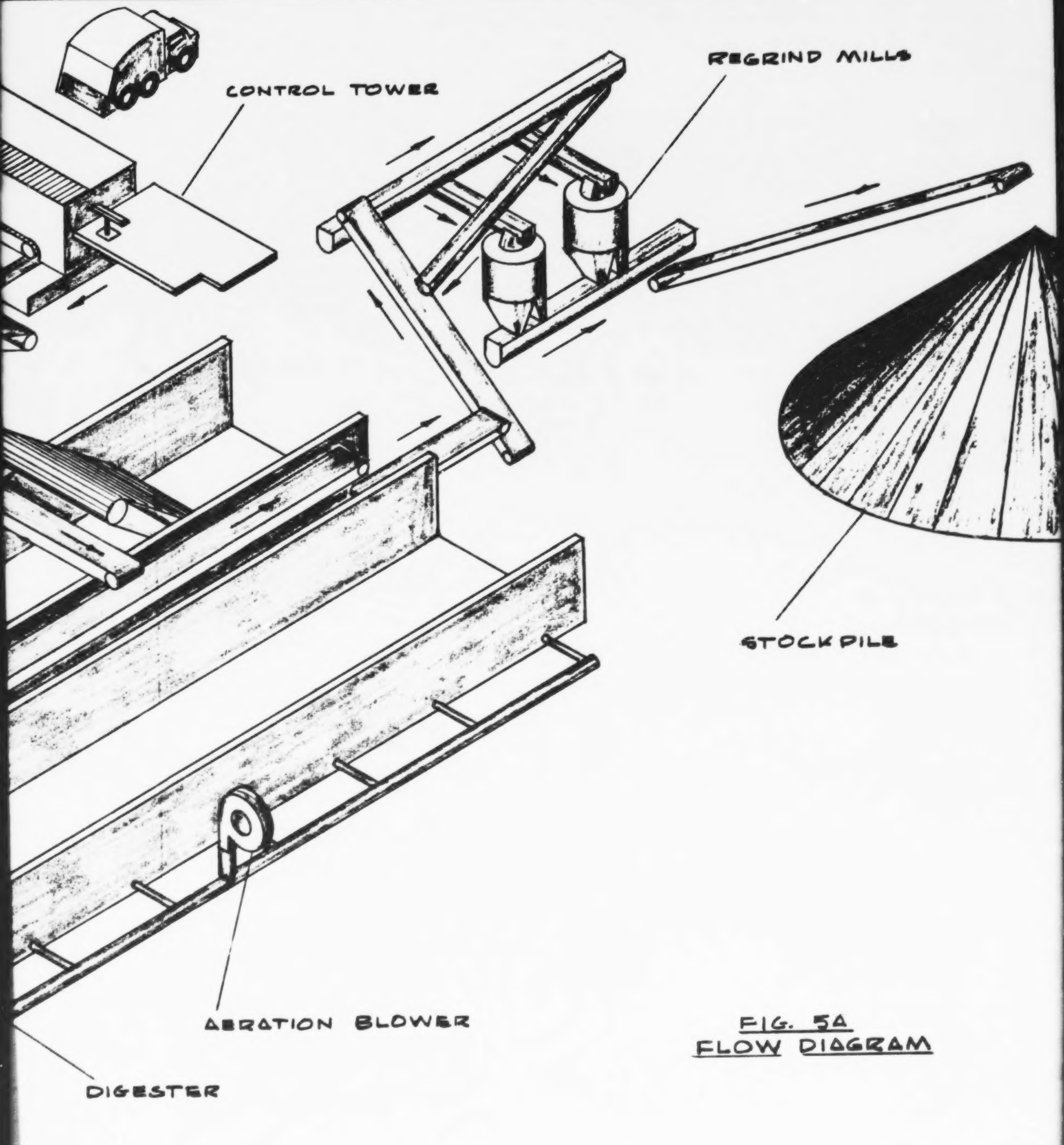

CONTROL TOWER
REGRIND MILLS
STOCKPILE
AERATION BLOWER
DIGESTER

FIG. 5A
FLOW DIAGRAM

C

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cards and giving a readout of 4 digits for truck identification and 5 digits for tare weight into printweigh and adding machine.

c. Adding Machine, equipped to provide in one operation the gross weight, subtraction of tare weight, the ability to maintain accumulated net subtotals, and to total and clear at the will of the operator. Adding machine can operate together with the card reader and the printweigh while Mode Selector Switch is in "Agency" position.

The system prints a cumulative tape for weighing while the Mode Selector Switch is in "Agency" position, and can also simultaneously print a separate weigh ticket for each load. When the Mode Selector Switch is in "Other" postion the tape does not print, but any number of separate weigh tickets showing truck number, gross and tare weights can be printed. City refuse trucks are normally weighed with the Selector Switch on "Agency" position, providing the City with a tape record. County and University refuse trucks, compost trucks, paper and metal trucks, and other loads are weighed in the "Other" position, separate duplicate weigh tickets being provided.

The weighing system can be operated manually if the card reader or the adding machine, or both, fail to function. A mode selector switch (to Manual) permits weighing other than refuse any time desired, and also disengages the adding machine but continues the use of the card reader and printweigh.

2. Receiving Hopper. After the trucks are weighed (Figure 6, Page 17) they proceed up a ramp to the unloading area. At this point, the refuse is dumped into the receiving hopper which is 66' long, 12' wide and 11'-5" deep (Figure 8). The capacity of the hopper is about 60 tons of refuse. An apron conveyor is located at the bottom of this hopper to carry the refuse toward the sorting area.

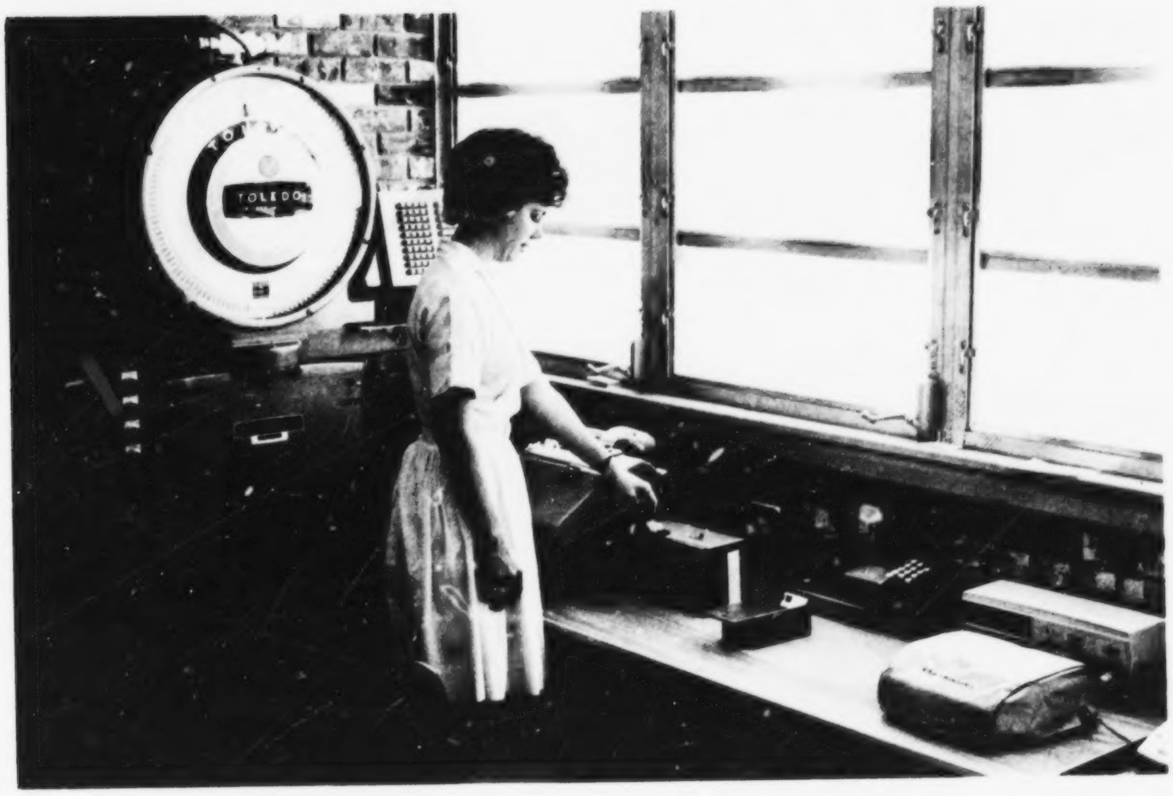


Figure 6 Scale Control System

The Receiving Hopper and Apron Conveyor are located at the rear of the Receiving Slab in the Receiving Building (Figure 7).

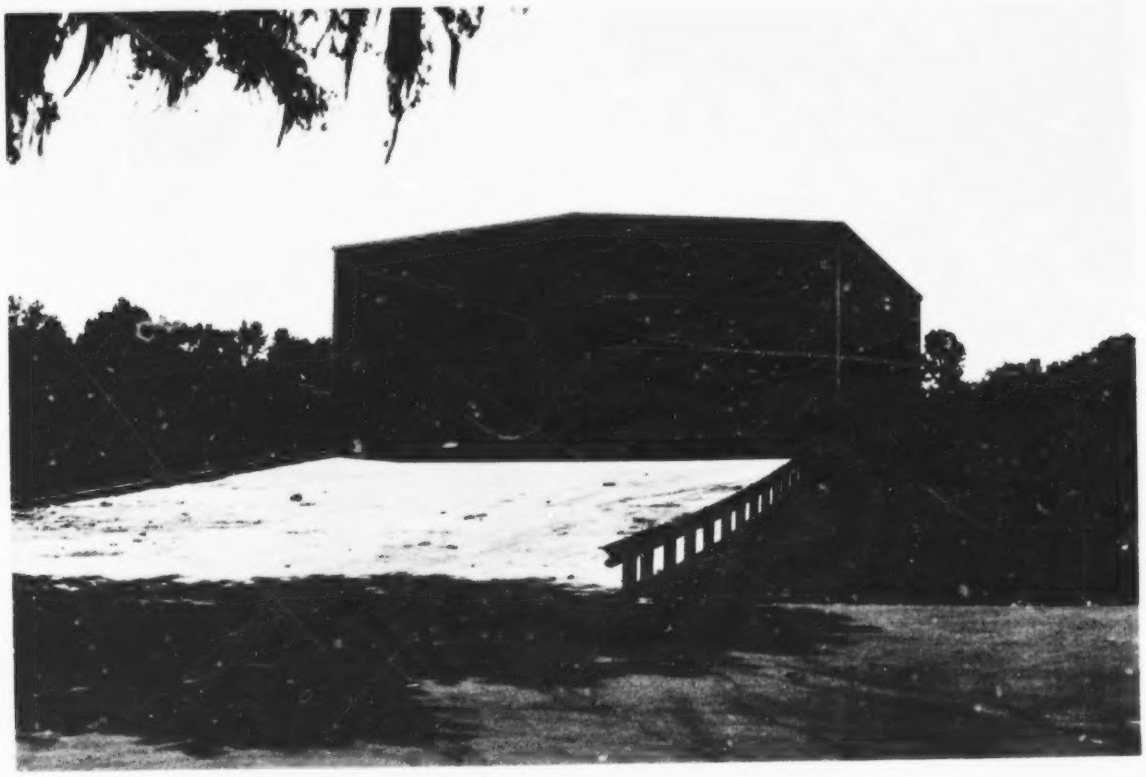


Figure 7 Receiving Building and Ramp

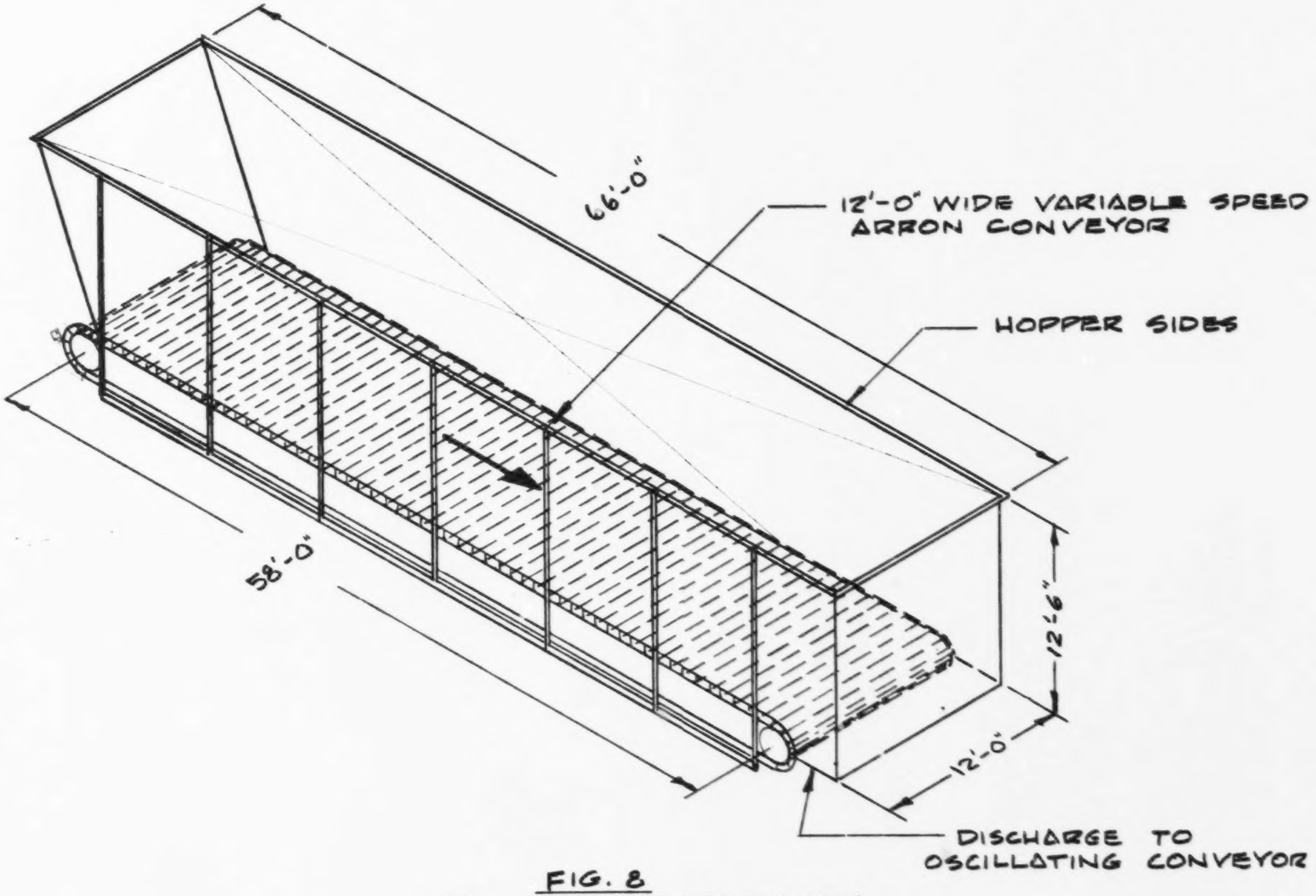

66'-0"
12'-0" WIDE VARIABLE SPEED
ARRON CONVEYOR
HOPPER SIDES
58'-0"
12'-6"
12'-0"
DISCHARGE TO
OSCILLATING CONVEYOR

FIG. 8
RECEIVING HOPPER WITH
APRON CONVEYOR

3. Apron Conveyor. The Apron Conveyor consists of a series of overlapping or interlocking apron pans which make up the bottom of the receiving hopper (Figure 8, Page 18). These same are attached successively to three strands of steel chain which are driven by a 2 HP U.S. Electrical Motors Varidrive, giving a variable conveyor speed of approximately 2 feet to 20 feet per minute. The Apron Conveyor is controlled from the control console. The Conveyor was manufactured by Gulf Machinery Company, Safety Harbor, Florida, using Link-Belt Company components. Gulf Model No. 74-6. The Apron Conveyor is designed to move the entire receiving hopper load which can be as much as 60 tons at 10 lbs. per cubic ft. and 25% moisture overall. Speed of the Apron Conveyor can be controlled to drop up to about 20 tons per hour into the oscillating conveyor.

4. Control Platform and Control Console. To regulate the flow of refuse material through the plant, a master control center is stationed on a high platform. This control platform is so located that the operator can oversee the entire system. The platform is 13' - 10" above the floor and is approximately 14' x 15' square. (Figure 9, Page 20.) The platform was manufactured on the site from drawings supplied by Metropolitan.

The Control Console consists of a 30" high column on which a control panel is fastened (Figure 10, Page 21). This panel contains start-and-stop switches for the following equipment: Apron Conveyor, Oscillating Conveyor, Sorting Belt, Primary Grinder, Ballistic Separator, Secondary Grinder, Intermediate Conveyor, two Screw Conveyors, Moyno Pump, Transfer Conveyor and Tripper Conveyor. The Sorting Belt and Apron Conveyors are also equipped with a fast-and-slow speed switch. All switches are plainly marked, using red lights to indicate when the machinery is in operation. The manufacturer was McCleery Engineering and Manufacturing Company, Inc., Downers Grove, Illinois.

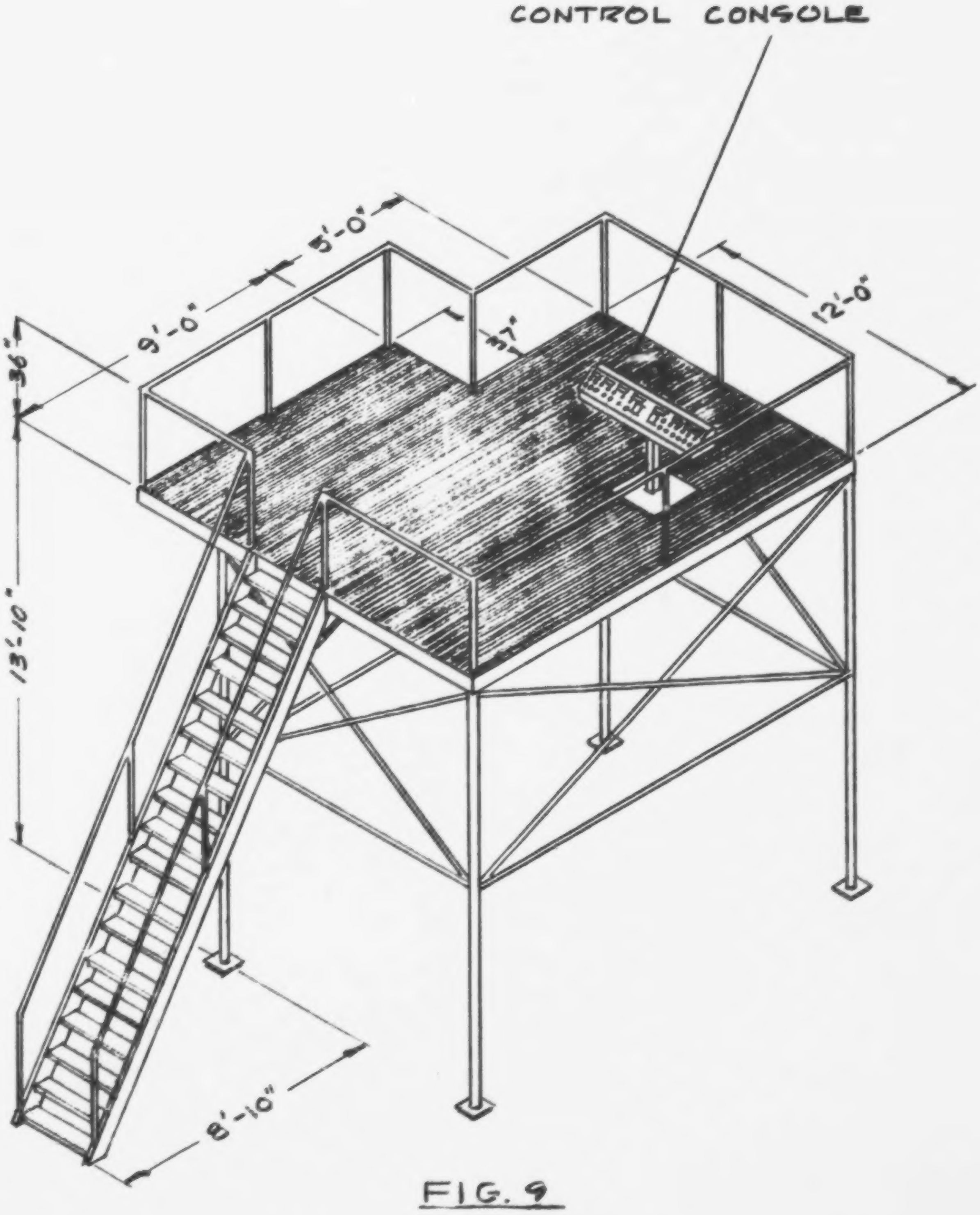

CONTROL CONSOLE
5'-0"
9'-0"
12'-0"
36"
37"
13'-10"
8'-10"

FIG. 9

CONTROL PLATFORM WITH CONSOLE

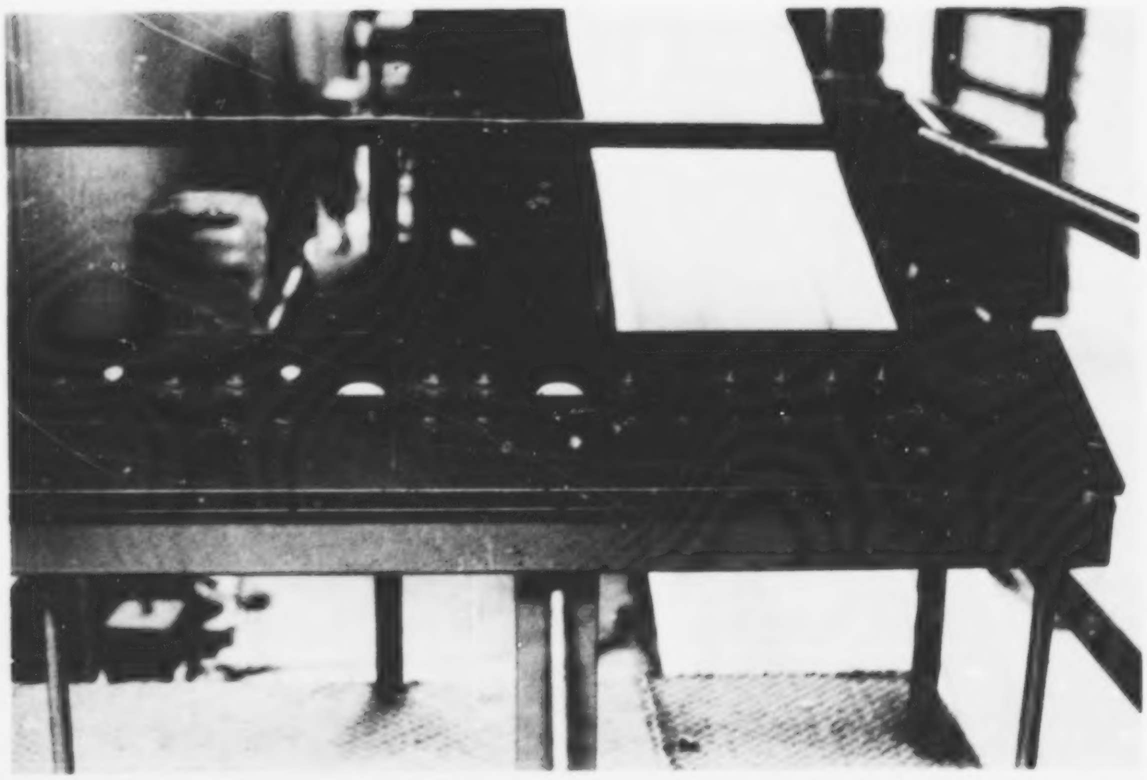


Figure 10 Control Console

5. Oscillating Conveyor. The Oscillating Conveyor receives refuse from the Apron Conveyor and feeds it to the Sorting Belt Conveyor. An oscillating conveyor is used here to break or loosen packed refuse, and to move the refuse in a smooth, continuous, uniform flow. In effect, it "meters" the amount fed to the sorting conveyor at a material flow rate of up to 20 tons per hour. This is accomplished by the upward and forward oscillating motion of a metal trough mounted on inclined reactor legs. A constant stroke eccentric drive provides a powerful surge-proof conveying action. The stroke is about 7/8", and the cycle rate is about 200 per minute. The Oscillating Conveyor is 20' long x 5' wide and 18" deep, and is powered by a 10 h.p. motor.

It is controlled from the Control Console to insure that the proper amount of refuse is fed onto the Sorting Belt. This conveyor is a coil-mounted type, manufactured by Link-Belt Company, Chicago.

6. Sorting Conveyor. The refuse is fed by the Oscillating Conveyor onto the Sorting Conveyor (Figure 11, Page 23, and Figure 12, Page 24), at a rate of up to 20 tons per hour. The Sorting Conveyor is a belt conveyor 83 feet long and 5 feet wide, which rises from below the floor level to the sorting platform, at a height of 15 feet. It is powered by a 5 h.p. U.S. Electrical Motors Co. vari-drive giving a variable conveyor speed of from approximately 10 feet per minute to 30 feet per minute. This unit is also controlled from the Control Console. The Sorting Belt was manufactured by Gulf Machinery Company, Safety Harbor, Florida, using Link-Belt Company components, and was assembled at the Gainesville site. Gulf Model No. 74-23.

7. Sorting Platform. (Figure 11, Page 23.) The refuse is elevated to the Sorting Platform where normally six sorters stand on the platform, three on each side of the sorting belt. Drop-out chutes are built into the platforms. As the refuse passes by on the conveyor belt the sorters manually remove salvage grade waste paper and cardboard, which are dropped down the chutes. Textiles and non-ferrous metals can also be removed manually. Normally, salvageable paper items will total about 4% to 8% of the input total, and textiles and non-ferrous items from ½% to 1%. Paper and cardboard are dropped into separate collector-conveyor systems which hold about one bale each, and feed automatically into the baler. Textiles and non-ferrous metals are sorted into container for salvaging. At the last station, materials which are non-salvageable and non-compostable (including such items as rubber hose, tires,

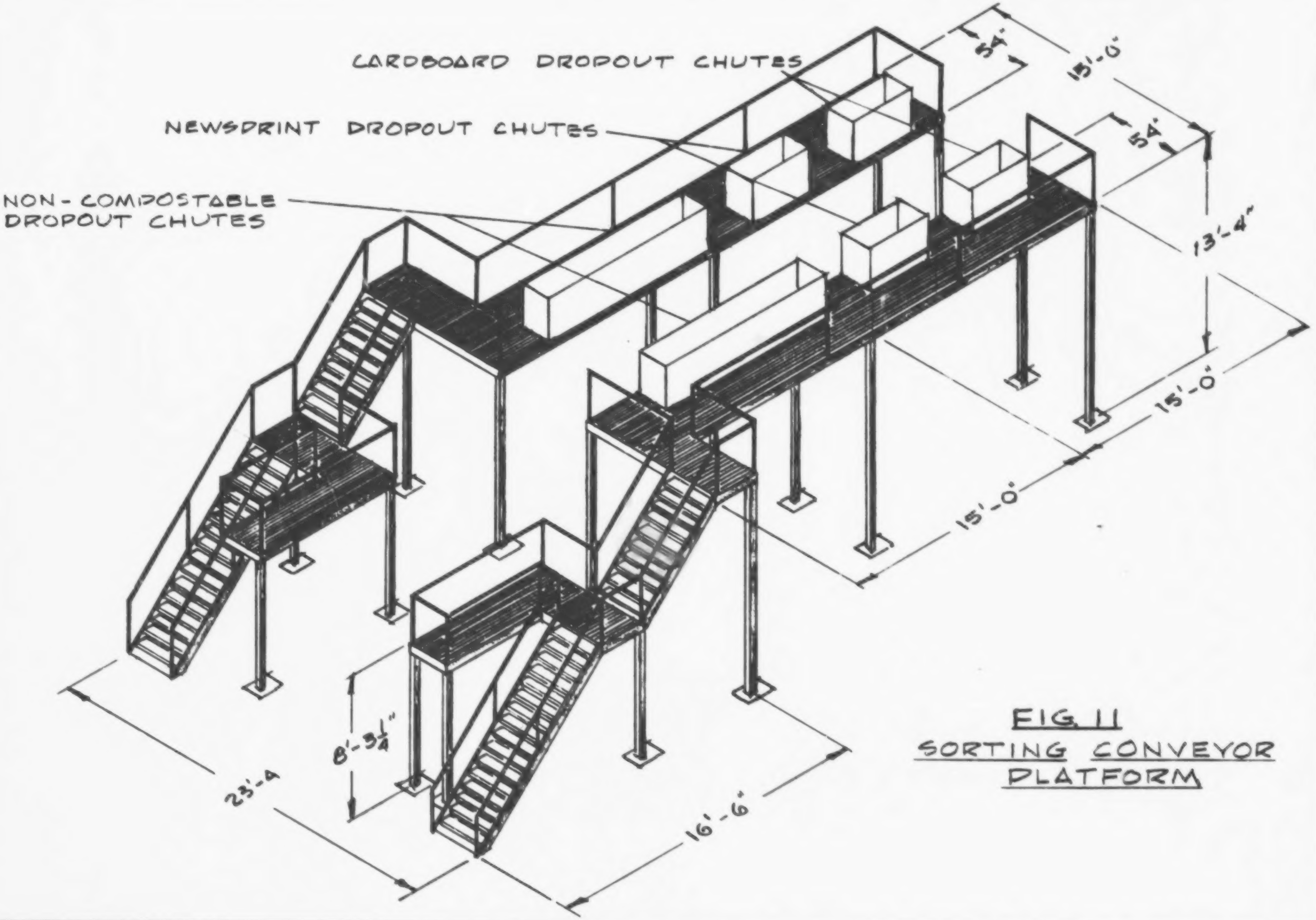

CARDBOARD DROPOUT CHUTES
NEWSPRINT DROPOUT CHUTES
NON - COMPOSTABLE DROPOUT CHUTES
54"
15'-0"
54"
13'-4"
15'-0"
15'-0"
23'-4
8'-3 1/4"
16'-6"

FIG. 11
SORTING CONVEYOR PLATFORM

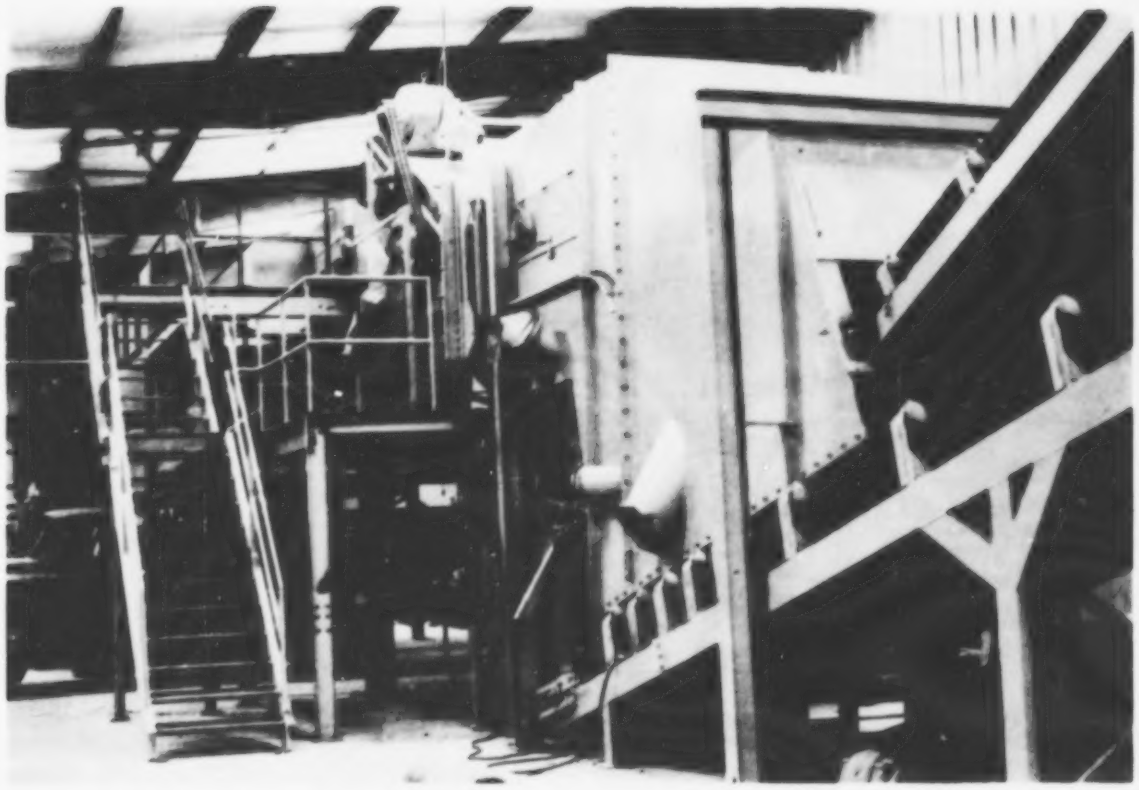


Figure 12 Sorting Platform, Centriblast Grinder and Ballistic Separator

broken furniture, mattresses, rugs, large plastic items, large bulky items, large branches, stumps, etc.) are also manually removed and dropped through the non-compostable chutes into a dump truck, to be taken to a landfill. These materials may compose 3% to 6% of the incoming refuse. The platform was manufactured by Gulf Machinery Co., Safety Harbor, Florida, from drawings by Metropolitan, and was assembled at the plant site. (Figure 12, Page 24.)

D. Paper Salvage System.

1. Collector Conveyor System. (Figure 13, Page 25.) The Sorting Platform is divided by the sorting belt into two separate sides. Each side has three drop-out chutes. These are arranged in pairs on opposite sides of the platform, the first pair feeding the first Collector-Conveyor, the second pair feeding the second Collector-Conveyor, and third pair the non-compostables

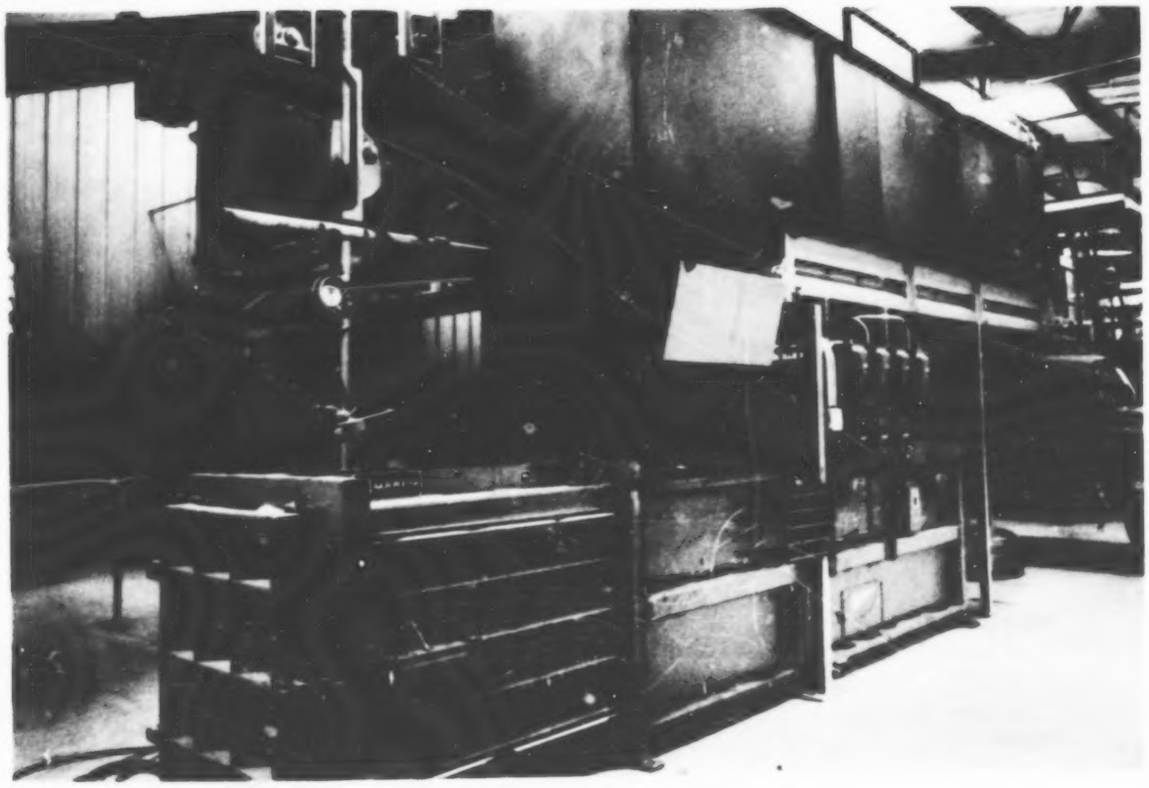


Figure 13 Baler and Collector-Conveyor System

truck. Normally, one Collector-Conveyor will be used for newsprint and other white papers, and the other for cardboard, corrugated and other kraft type papers.

The Collector-Conveyors run underneath the sorting platform at right angles to the sorting belt. One serves the two newsprint chutes, and the other the cardboard chutes. These conveyors are identical, and are about 4 feet below the chutes, creating storage for about 1½ bales of newsprint or about 1 bale of cardboard. A common belt conveyor (Baler Conveyor) connects the 2 cross-conveyors with the baler. Since either the newsprint or the cardboard conveyor is allowed to fill while the other is feeding the baler, only one baler is needed to bale the two different types of salvage paper.

The two cross conveyors and the collector conveyor were all manufactured by Gulf Machinery Company, Safety Harbor, Florida. The cardboard collector is Model No. 74-47, the newspaper collector is Model 74-42, and both conveyors are 48 inches wide by 16 feet long. The Baler Conveyor is 36 inches wide by 15 feet long, and is Model 74-43. All three conveyors are driven by 1 HP electric motors and have a final belt speed of about 80 feet per minute.

2. Baler. The baler for the plant was manufactured by the Maren Engineering Corporation of South Holland, Illinois. Its baling chamber is 60" long by 30" wide by 42" high. The operating pressure of 1500 P.S.I. can compress a bale of corrugated cardboard up to 1,000 lbs. per bale. The total length of the baler is 18 feet long and its weight is approximately 7,000 lbs. (Figure 13, Page 25.)

E. Grinding System.

1. Crusher-Disintegrator. After the refuse has passed the sorting area and most of the salvageable cardboard, paper and other materials have been manually removed, the remaining refuse is fed directly into a crusher-disintegrator. (Figure 14, Page 27). This machine was manufactured by the Centriblast Corporation, a subsidiary of the Joy Manufacturing Company, Pittsburgh, Pennsylvania.

In the operation of the machine, refuse is force-fed into the crushing section by "live" top and bottom sections of the feed hopper. This system consists of converging upper and lower apron conveyors, each driven by a 7½ HP gear-motor. The upper gear-motor also drives the slow-revolving star wheel mentioned below. The feed-end is large enough to receive fairly

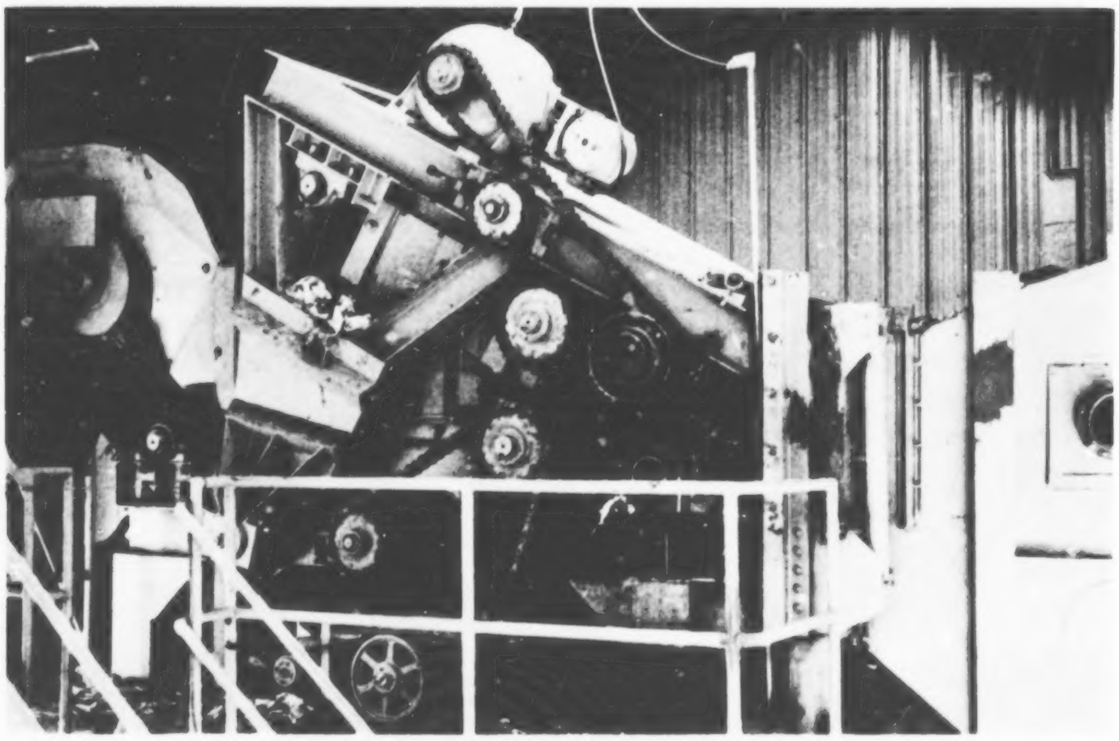


Figure 14 Crusher-Disintegrator

bulky items. The largest article handled to date without causing a jam or a major breakdown was a heavy cardboard box about 30 inches high by 36 inches wide. Incoming refuse is forced toward the disintegrator section, and is crushed into a flattened mass about 4 inches thick which passes through the small discharge opening.

At the discharge end the refuse mass is gripped by a slowly revolving "star" shaft with equally spaced star-shaped rings or wheels. Parallel to this shaft is a high speed "disintegrator" shaft with heavy-duty impactors spaced to rotate between the star rings on the star shaft. This shaft is driven by a 300 h.p. electric motor, and rotates at up to 1,000 RPM. The shafts are so arranged that the impactors and star wheels comb through each other. Both star wheels and impactors make point penetration of the refuse. The star acts as an anvil for a secondary tearing action. In addition, the close clearance between the impactors and the star wheel shaft provides a third disintegration effect, a shearing action.

The particle size varies with the type of material being fed into the machine, but for general refuse the average size discharged is about 3 inches by 3 inches.

2. Ballistic Separator. The refuse at this point has passed through the Grinder-Disintegrator and is discharged at a high velocity into the Ballistic Separator (Figure 15, Page 28). The principal of the Ballistic Separator is separation by momentum of individual materials. The more dense particles (mostly metal) will be thrown farther than the lighter particles (such as paper and compostable material). The metals and other heavier materials are ballistically separated on to an upper discharge belt conveyor which

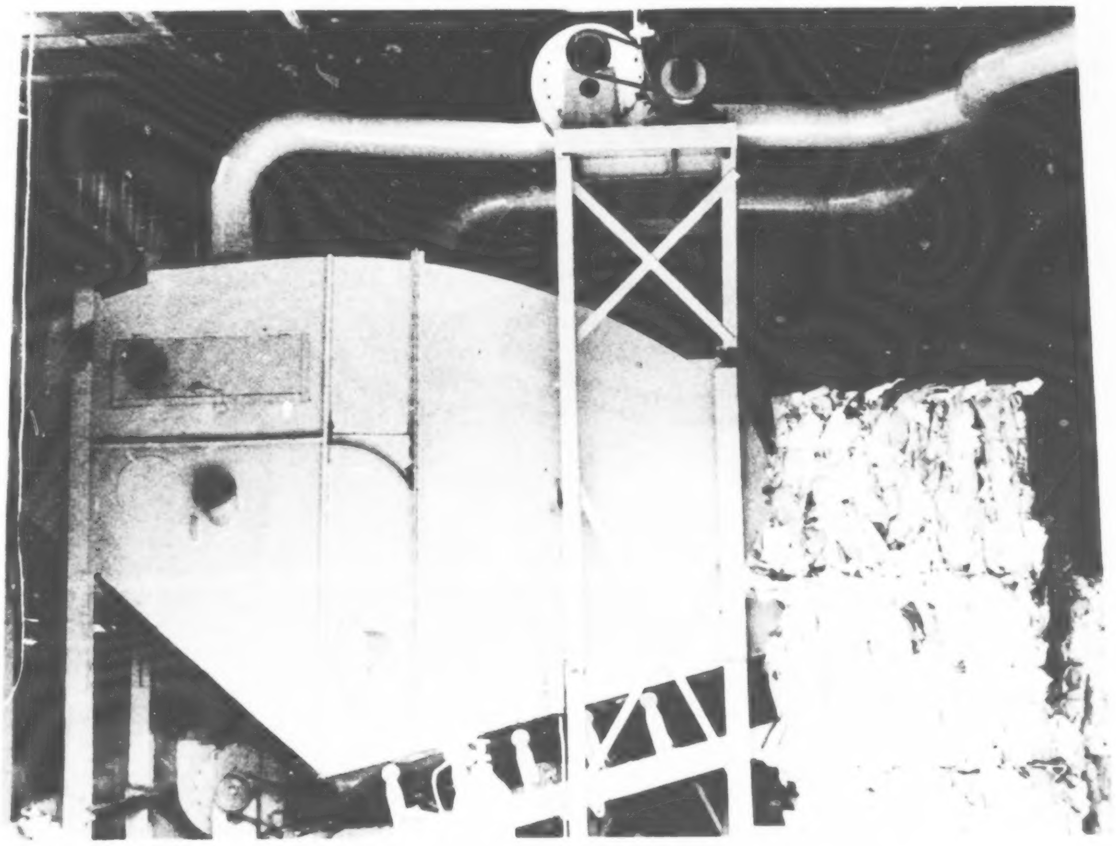


Figure 15 Ballistic Separator

conveys the material to the can conveyor. (Figure 5 A, Page 15.)

The lighter materials that fall nearer the Grinder-Disintegrator are caught in a hopper which discharges into a slinger. This slinger is a high speed belt which accelerates the heavier materials and gives this heavier material velocity to provide a second step for ballistic separation, again separating any heavier materials which are conveyed to the can conveyor. The speed and angle of slope of the belt will be adjusted on the "cut and try" method to attain optimum separation. All materials that are not thrown onto the upper discharge belt conveyor by ballistic force fall on to the lower discharge belt conveyor and are conveyed to the secondary grinder.

Located at strategic points in the sides of the ballistic separator are two air inlets and two suction ports where two blowers using variable speed drives supply air to the inlets and two blowers (also variable speed) supply suction for the suction ports. Paper, plastics and other very light materials are removed with this air system and blown into a burner, giving efficient disposal and providing a useful source of heat for processing.

The ballistic separator is made of ¼ inch mild steel plate with abrasive resistant wear plates bolted to the inside wearing surfaces. There are two upper access doors near the top of the separator which are used for ease of maintenance on the Grinder-Disintegrator. One large walk-through door is located lower on the separator just above the lower discharge belt which will be used for cleaning purposes, also six glass ship portholes are used in the sides of the separator for viewing the operation of the separator. This unit was manufactured by Dan B. Vincent, Inc., Tampa, Florida. The upper discharge belt was manufactured by Gulf Machinery Company, Safety Harbor, Florida, their model number 74-25. It is driven by a 1 h.p. electric motor (1800 RPM), is 30 inches wide by 23 feet long, and will convey approximately 0.4 tons per hour of metal from the ballistic separator to the can conveyor at about 106 feet per minute.

The slinger is a 30 inch wide high-speed belt traveling at from 1500 to 3500 feet per minute, and is driven by a 7½ h.p. motor on a sliding variable-speed motor base having a three-to-one ratio variable-type motor belt pulley. It was originally manufactured by Stephens-Adamson Corporation, Aurora, Illinois, and modified by Dan B. Vincent, Inc., Tampa, Florida, to fit the ballistic separator.

3. Secondary Grinder. After the refuse has been separated by the Ballistic Separator (Figure 14, Page 27), the material which is to be composted is carried by the lower discharge belt conveyor to the secondary grinder. The belt was manufactured by Gulf Machinery Company, Safety Harbor, Florida, model number 74-24. It is driven by a 5 h.p. electric motor and has a belt speed of about 150 feet per minute. It is 60 inches wide by 46 feet long and can carry approximately 18 tons per hour of refuse.

The Secondary Grinder performs an important role by reducing the particle size which in turn increases material density, and so increases digester capacity. This in turn reduces the per-ton capital outlay for digester capacity. Another plus is that a small particle size speeds up bacterial action and reduces composting time thereby helping to achieve one of the basic requirements of successful commercial composting. The secondary grinder is a hammer mill type, manufactured by Williams Patent Crusher and Pulverizer Company, St. Louis, Missouri, Model GA70, with a rated capacity of 20 tons-per-hour. The overall size is 68 inches wide by 132 inches long and 58 inches high, weighs 19,500 pounds, and has 38 50-pound hammers and is driven by a 400 H. P. 1200 RPM electric motor. This machine reduces the material by impact from hammers striking the material and reducing the material until it is fine enough to pass through the openings in a screen or grate located at the lower section of the grinder. Grates can be varied to control particle size. Optimum particle size is about 1 inch maximum. After passing through the grates, the material drops into the Mixing Screws (Figure 18, Page 33).

F. Sludge Handling System

1. Mixing Screws. After the refuse has been discharged from the bottom of the secondary grinder, it falls into the mixing screws where two counter-rotating ribbon-type screws, placed side by side in a common trough, blend

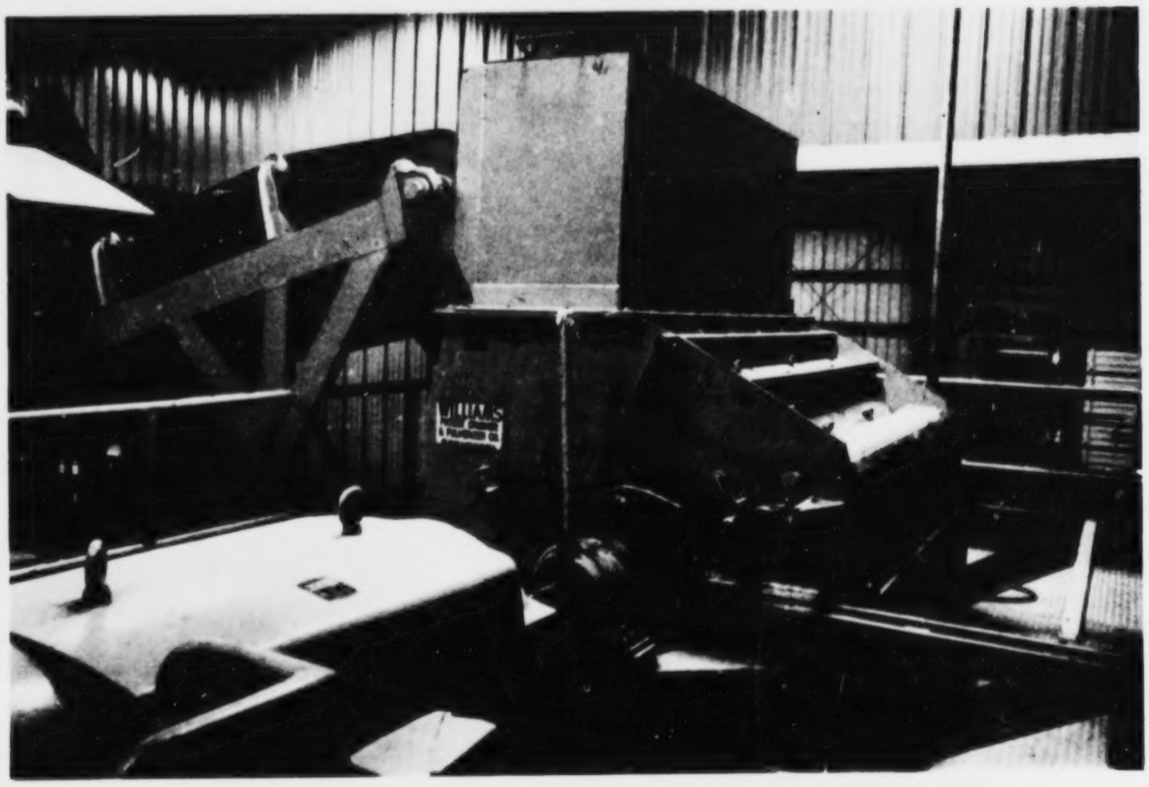


Figure 16 Secondary Grinder

the material with the sludge as it is moved down the trough. At this point in the process, the material is normally too dry for composting and it has been found advantageous to introduce moisture (which can be either water or wet sewage sludge) under controlled conditions. The twin screws thoroughly mix together the introduced moisture and dry refuse. The maximum moisture content of the material entering the compost system should be 50 to 65 per cent. Since mixed refuse normally ranges from 20 to 25 per cent moisture, additional liquid should be added to the shredded refuse prior to composting. Sludge from the adjacent City Sewage Treatment Plant will normally be used as the moistening agent.

The mixing screw and trough were manufactured by Gulf Machinery Company, Safety Harbor, Florida, model number 74-29. The screws are 16 inches diameter, and the trough measures 34 inches wide by 12 feet long. Each screw is driven by a 3 H.P. electric motor giving a speed of 45 RPM. The screws will convey all material from the secondary grinder, about 19 tons per hour (Figure 16, Page 31).

2. Sludge Tank. Sludge from the City Sewage Treatment Plant, adjacent to the compost plant, will be pumped by the City at a uniform rate into a concrete sludge storage tank, located near the grinding and sorting building of the compost plant (Figure 17, Page 33; Figure 19, Page 34; and Figure 20, Page 35). The Sludge Tank is 18 feet by 18 feet square by 16 feet deep, with outer walls 1 foot thick. It has a sloping bottom to a center trough, at one end of which is the outlet pipe for the sludge pump. Use of the sludge storage tank permits the plant to accept sludge from the City at a uniform rate, and still obtain flexibility for maximum surge supply when the plant is operating at full capacity or none when no refuse is moving.

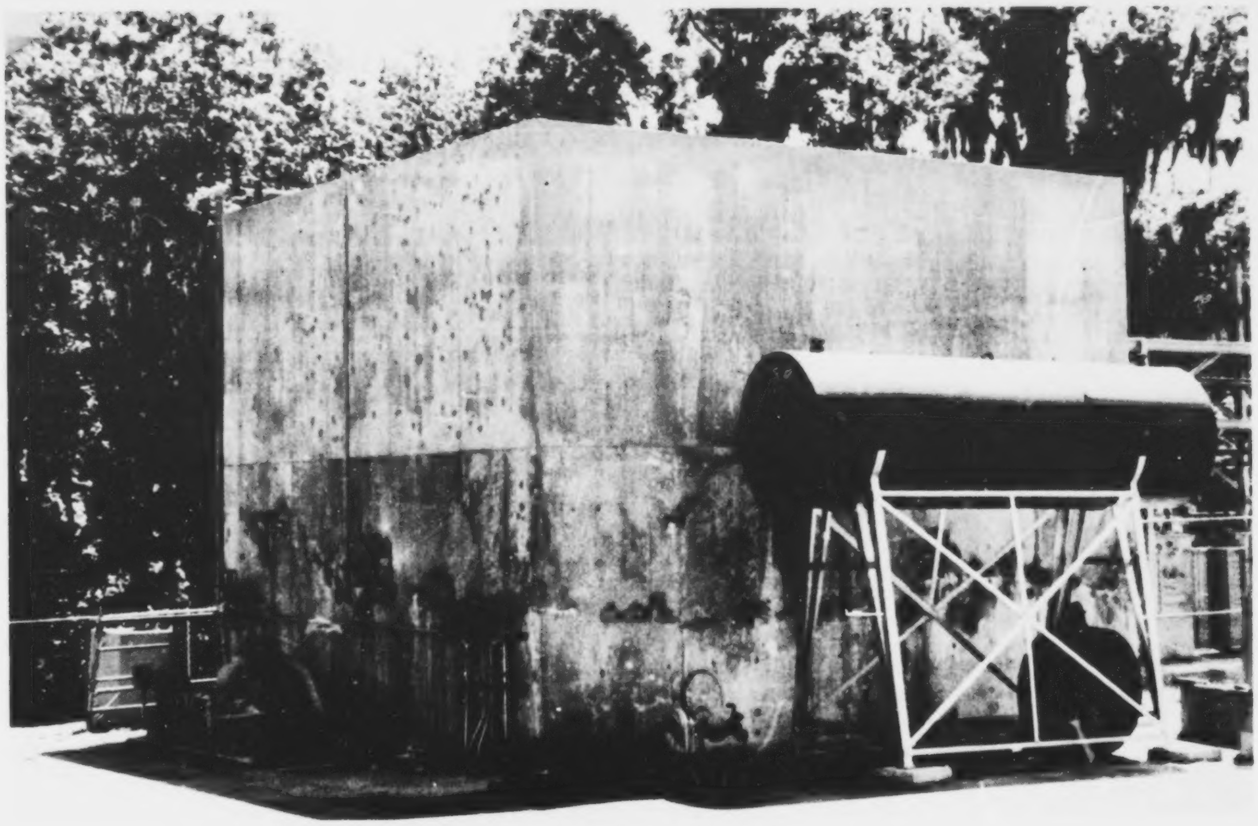


Figure 17 Sludge Storage Tank, Sludge Pump and Sludge Aeration Blower

It is expected that the sludge pumped from the City Treatment Plant will contain 4 to 5 percent solids by dried weight. It is planned that the City will arrange the piping in its plant so that the sludge being pumped to the compost plant can

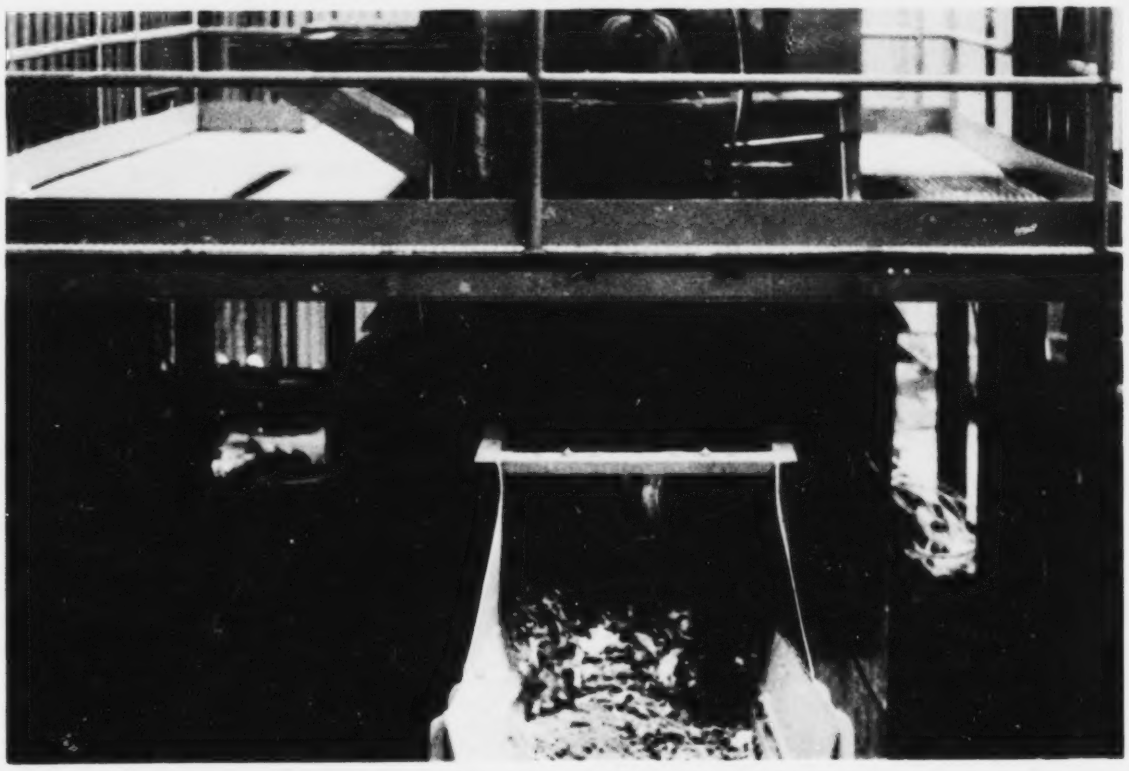


Figure 18 Sludge Mixing Screws Underneath Secondary Grinder

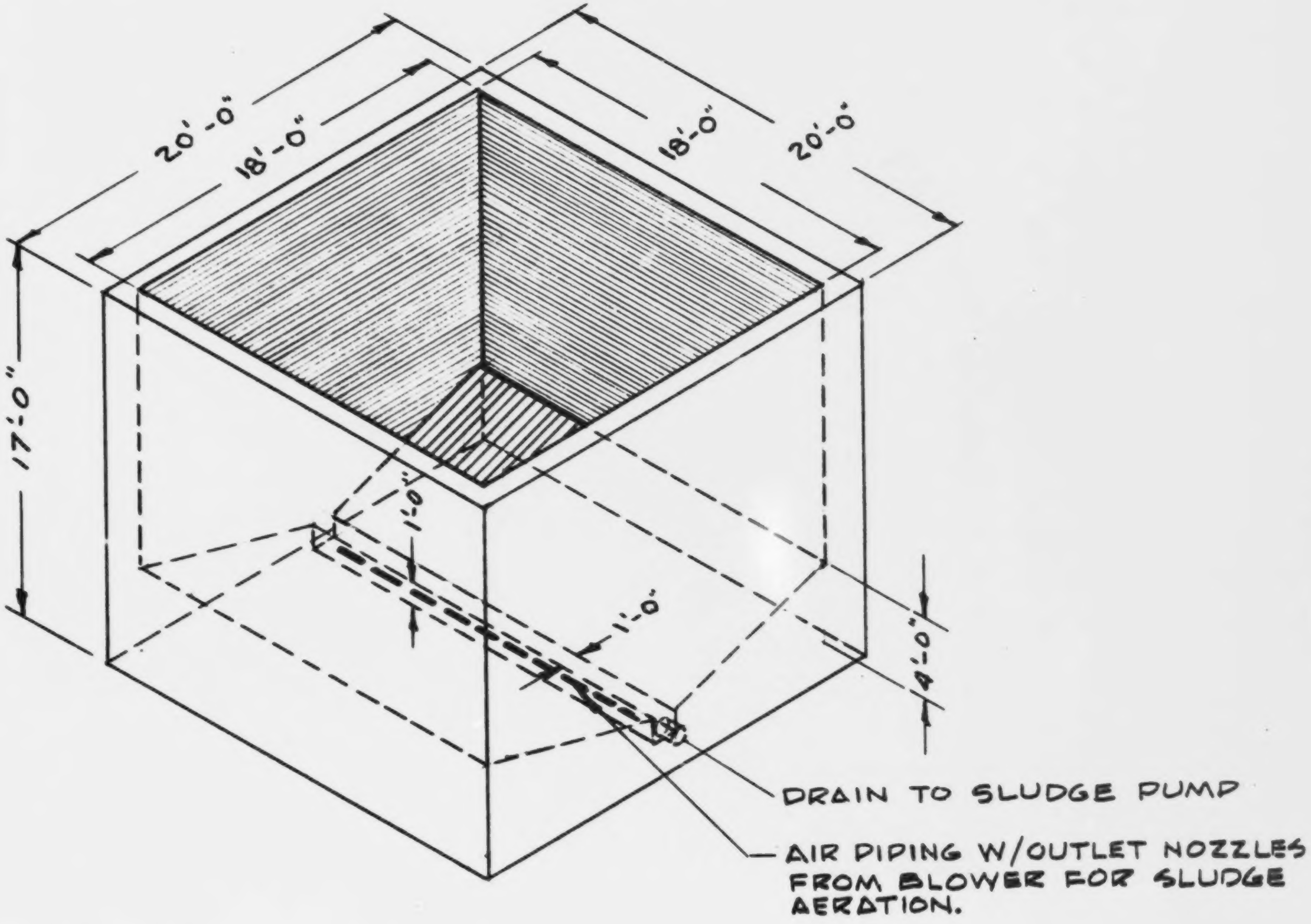

20'-0"
18'-0"
18'-0"
20'-0"
17'-0"
1'-0"
1'-0"
4'-0"
DRAIN TO SLUDGE PUMP
AIR PIPING W/OUTLET NOZZLES FROM BLOWER FOR SLUDGE AERATION.

FIG. 19

SLUDGE STORAGE TANK

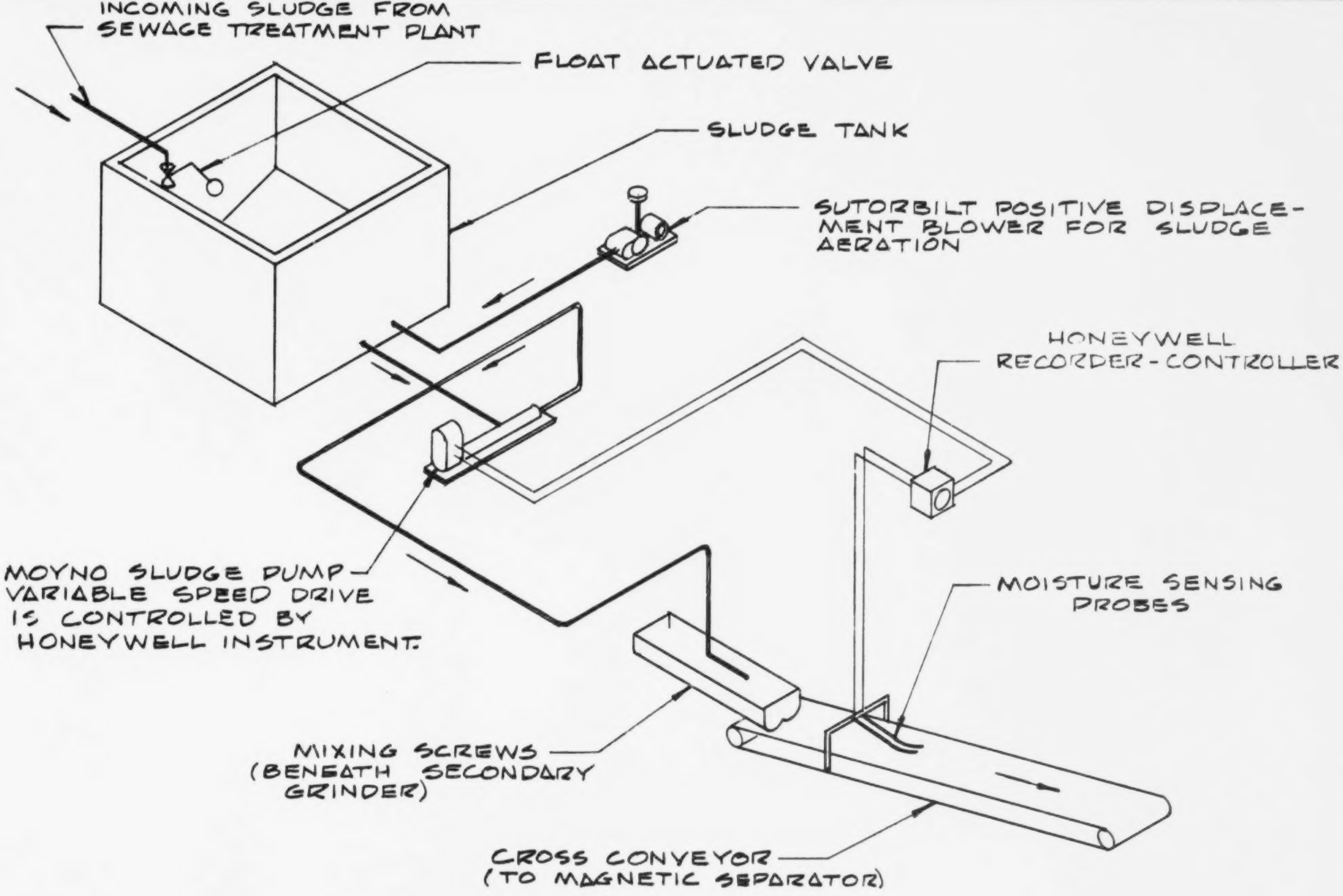

INCOMING SLUDGE FROM SEWAGE TREATMENT PLANT
FLOAT ACTUATED VALVE
SLUDGE TANK
SUTORBILT POSITIVE DISPLACEMENT BLOWER FOR SLUDGE AERATION
HONEYWELL RECORDER-CONTROLLER
MOYNO SLUDGE PUMP VARIABLE SPEED DRIVE IS CONTROLLED BY HONEYWELL INSTRUMENT.
MOISTURE SENSING PROBES
MIXING SCREWS (BENEATH SECONDARY GRINDER)
CROSS CONVEYOR (TO MAGNETIC SEPARATOR)

FIG. 20
SLUDGE HANDLING SYSTEM

be either digested sludge, pumped direct from the digesters without further dewatering, and also that undigested sludge can be pumped direct from the clarifiers, without dewatering. Solids content from the undigested sludge is expected to be lower than that in the digested sludge, but projections are that the compost plant will be able to absorb all of the solids from the sewage treatment plant. Assimilation of the undigested sludge will not be conducted on a regular basis until it has been established that the necessary standards of sanitation and public health have been met.

3. Sludge Pump. A "Moyno" brand "Progressing cavity" pump is used to convey sludge from the tank to the mixing screws. The pump is manufactured by Robbins Myers, Inc. pump division, Springfield, Ohio, Model number SW8. The pump is driven by a 3 HP U.S. Electrical Motors "Varidrive" unit with a 4 to 1 variable ratio. This gives an output of 10 gallons per minute at 105 RPM to 50 gallons per minute at 420 RPM. The Varidrive unit is controlled by a Honeywell Automatic Moisture Sensing device.

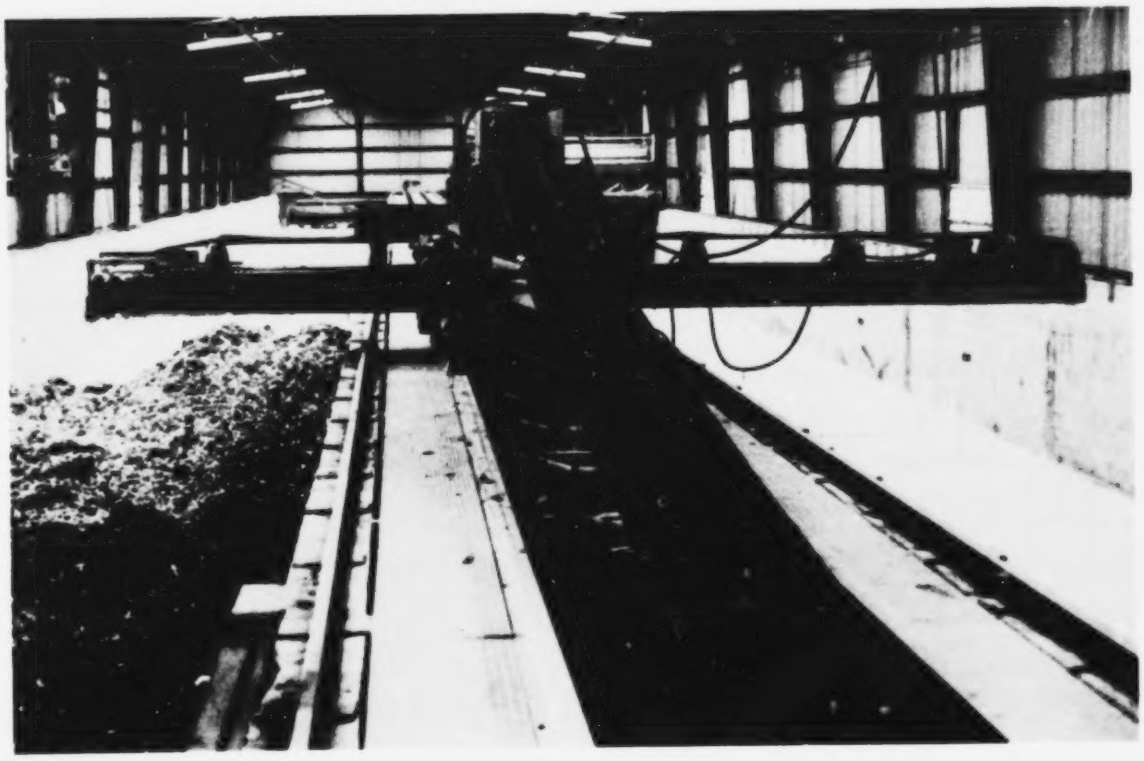


Figure 21 Tripper Belt Conveyor
(Front view)

4. Automatic Moisture Sensor. The moisture sensing device uses electrical conductivity between two electronic sensing electrodes. These are two metal shoes, 1¼ inches wide x 4¼ inches on center, which are mounted on a pivoted arm riding on the surface of the ground refuse. The electrodes comprise one leg of an A.C. bridge circuit. This signal is used to control the variable-speed drive on the Moyno Pump which meters sludge from the tank to the mixing screws beneath the secondary grinder. The pump can also be manually controlled, on or off, from the Control Console. (Figure 9, Page 20). The input signal from the probes passes through a recorder which maintains a continuous record of the moisture content of the raw refuse.

5. Sludge Aerating System. The city sewage sludge in the Sludge Storage Tank is kept aerobic by continuous aeration with air supplied by a positive pressure blower located at the side of the sludge tank. This air is supplied through nozzles in a pipe manifold at the bottom of the tank. This positive pressure blower is manufactured by Sutorbilt Corporation, Compton, California, Model No. 3H. It is rated at 42 CFM at 2.5 PSI, operates at 1670 RPM, and is powered by a 3 HP electric motor.

6. Moist Refuse Conveyor. After having been mixed with sludge, the refuse drops on to a 30 inch wide by 26 foot long belt conveyor, which conveys it under an electro-magnetic separator (Figure 28, Page 48, and Paragraph I-1, Page 49) and into the digester system. This conveyor was manufactured by Gulf Machinery Company, Safety Harbor, Florida, Model No. 74-20. It is driven by a 2 HP motor giving a final belt speed of about 250 feet per minute.

G. Digester System

1. Tripper Belt Conveyor (Figure 21, Page 36). After the refuse has passed under the magnetic separator (Figure 27, Page 47, and Figure 28, Page 48), and the ferrous metal has been removed, it is then carried by the Tripper Belt Conveyor (Figure 21, Page 36) to the Tripper (Figure 22, Page 39), which unloads the ground and moistened refuse into the digester tanks (Metro-Waste Patent No. 3,323,896). The tripper belt is 300 feet long, 18 inches wide, moves approximately 450 feet per minute, and is driven by a 7½ HP gearmotor. The tripper belt travels the full usable length of the digester tanks.

2. Tripper (Figure 22, Page 39). This machine travels on a set of rails between the two digester tanks. The tripper conveyor belt, loaded with refuse, passes in succession around two large reversing idlers, in this process discharging the refuse onto the tripper shuttle conveyor mounted on the front of the tripper. The Tripper is manufactured by Link-Belt, and was modified by Gulf Machinery, to Metropolitan specifications. It travels approximately 50 feet per minute and is driven by a 1 HP motor. The unique design of this machine allows the refuse to be discharged into the digesters at any point along the length of the tripper belt conveyor. The tripper can be manually controlled or can be set to travel back and forth automatically over any given section of either digester tank.

3. Tripper Shuttle Conveyor. This companion to the Tripper Conveyor (Figure 21, Page 36) is positioned at 90° to the tripper belt and is designed to discharge the refuse evenly into the digesters by moving the discharge end to any position over either digester. This is done by manually winching the shuttle back and forth as required, using a cable-operated winch system.

The refuse to be composted is conveyed on the tripper belt, which carries it to the tripper, which discharges it onto the shuttle conveyor belt. This transfer is accomplished by means of a movable tripper device which elevates the loaded belt and then passes it successively over two large reversing idlers. The material is then carried by the shuttle conveyor to the desired area in the digester tanks. The shuttle conveyor was manufactured by Gulf Machinery Company, Safety Harbor, Florida, Model No. 74-40. It is powered by a 1 HP electric motor. The belt speed is approximately 475 feet per minute.

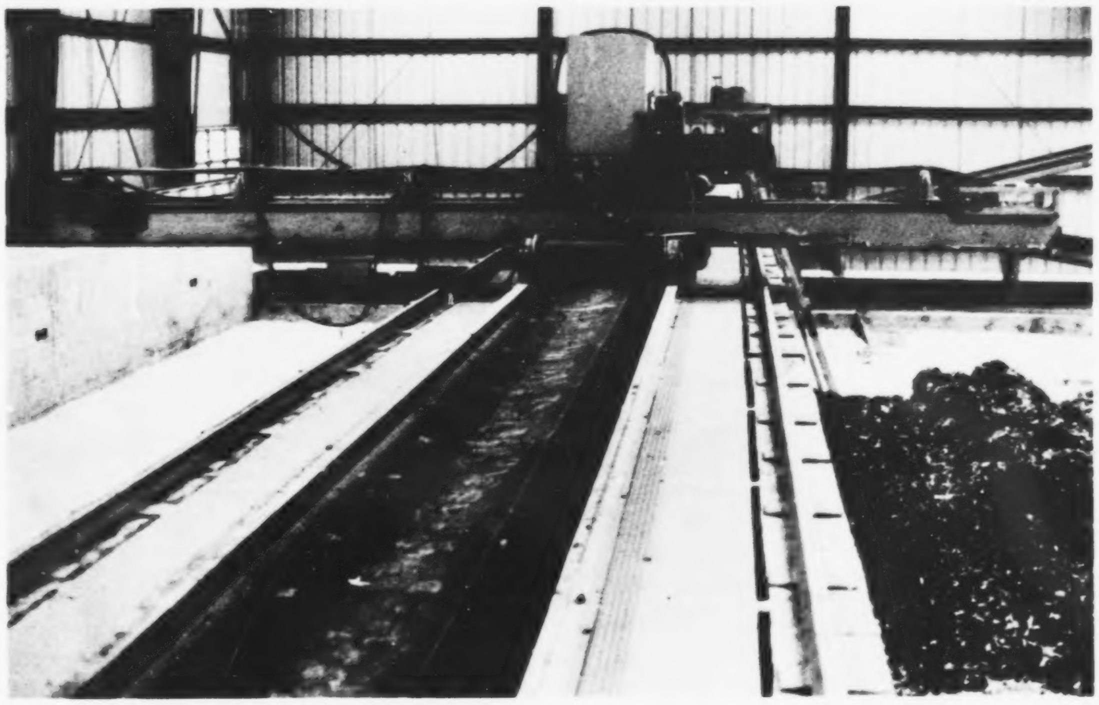


Figure 22 Tripper and Shuttle Conveyor
(Rear view)

Due to the length of the Tripper Belt Conveyor, it is at times possible to load and unload the Digester Tanks at the same time. Unloading is accomplished by a machine called the Agi-Loader (Metro-Waste Patent No. 3,294,491). (See Paragraph G-6, Page 42, and Figure 23, Page 40, and Figure 25, Page 44). This machine lifts the digested refuse out of the Digester Tanks and deposits it back to the Tripper Belt Conveyor, which carries the compost material to the Discharge Conveyor System, leading to the Final Grinders (Figure 26, Page 46).

4. Digester Tanks. There are two digester tanks (Figures 23 and 24), which are concrete troughs 330' long by 20' wide by 9' deep, designed to speed the composting process. The walls are constructed of concrete blocks and the floor is covered with perforated galvanized steel plates. The perforated steel plates are made from 20 ga. galvanized steel sheets. The face of the plate is 7 inches wide with a 1-3/8 inch deep channel lock to hold each plate in position. Each panel has rows of staggered air slots 1¼ inch long on 1-3/4 inch centers, (rows are 3/4" apart) and the slots are extruded to a height of 1/8 inch to 3/16 inch, the extrusion being at an angle to partially shield the slot from foreign material. These extrusions provide a total opening in the plate of about 14%. This perforated floor is also rated to support a possible loading of 6000 pounds per square foot. These perforated plates are above an

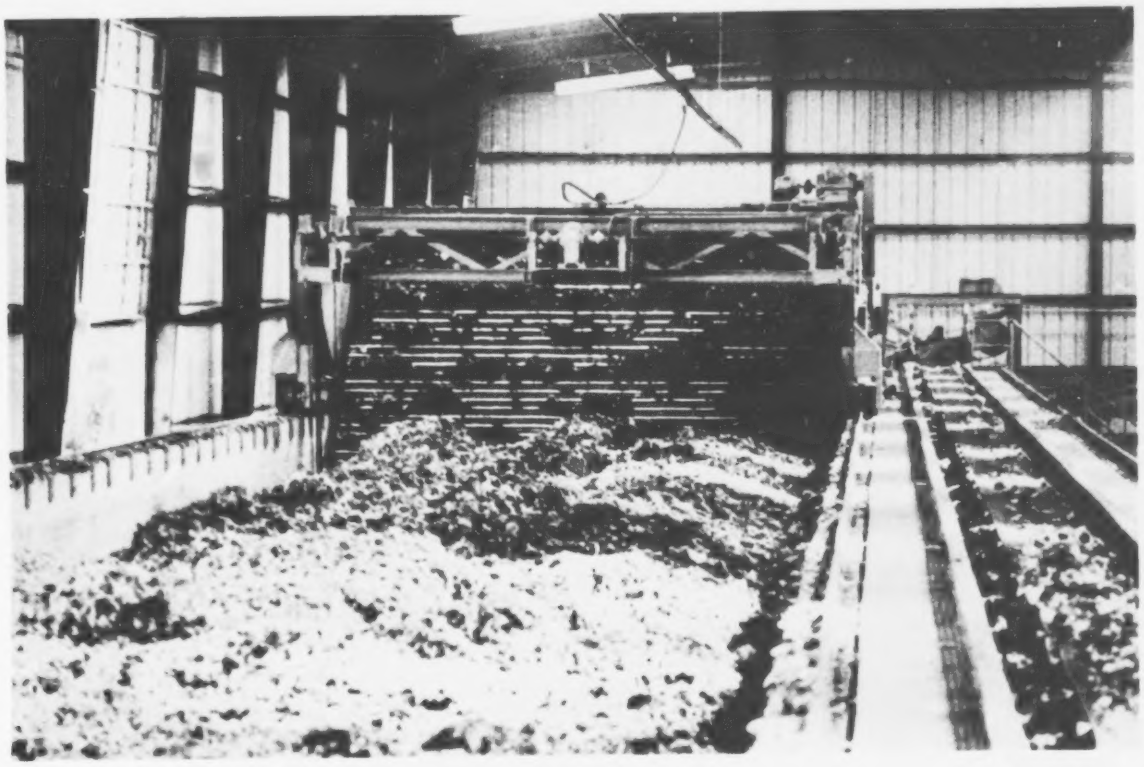
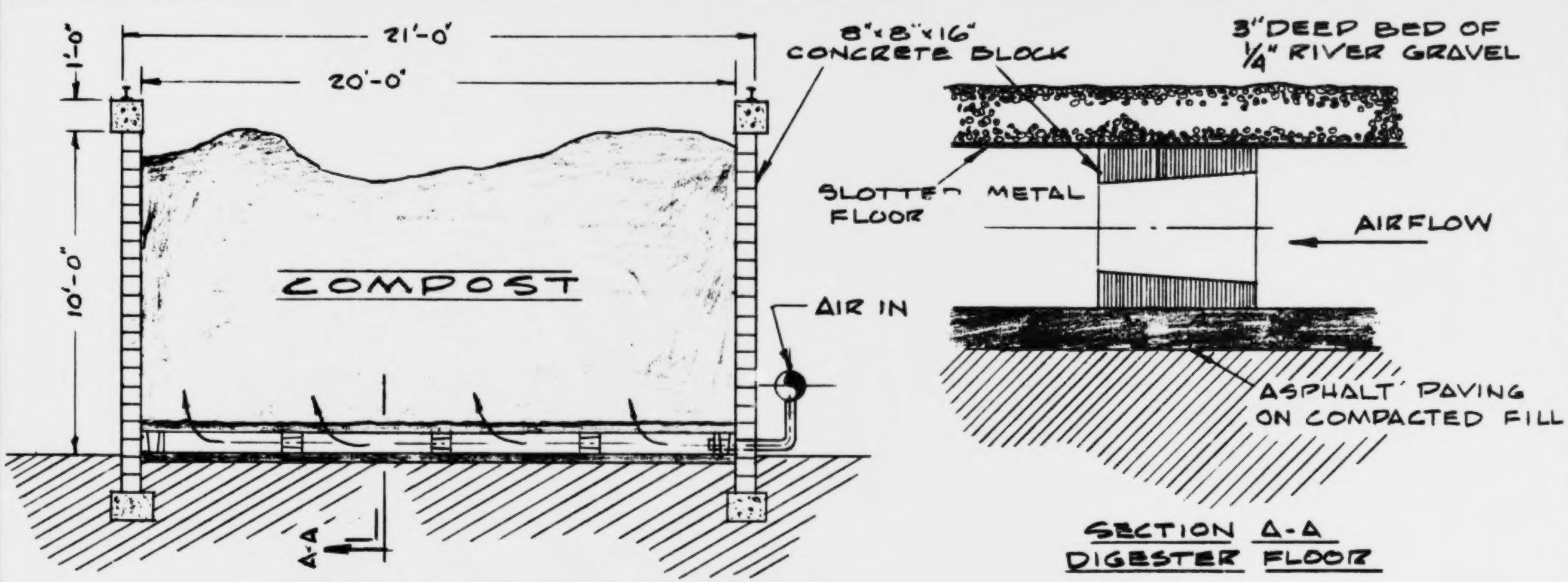


Figure 23 Digester Tank and Agi-Loader


21'-0'
20'-0'
1'-0"
10'-0"
8"x8"x16"
CONCRETE BLOCK
COMPOST
AIR IN
A-A
3"DEEP BED OF
1/4" RIVER GRAVEL
SLOTTED METAL
FLOOR
AIRFLOW
ASPHALT PAVING
ON COMPACTED FILL

DIGESTER CROSS SECTION

SECTION A-A
DIGESTER FLOOR

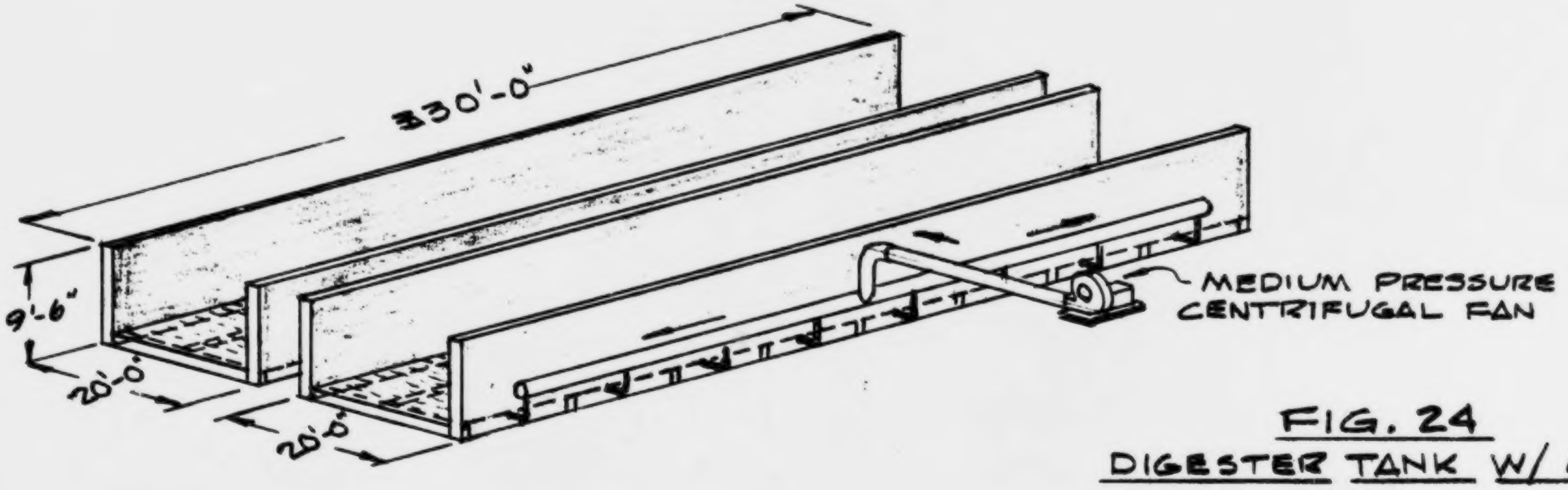

330'-0"
9'-6"
20'-0"
20'-0"
MEDIUM PRESSURE
CENTRIFUGAL FAN

FIG. 24
DIGESTER TANK W/ AIR SYSTEM

air plenum into which air is blown by a direct connected centrifugal low pressure fan made by Peerless Electric Division of H. K. Porter Co., Inc., Warren, Ohio. The fan provides 5,000 cubic feet per minute at a static pressure of 9.0 inches water column. The fan requires a 15 HP electric motor. The floors are manufactured by Pennington Manufacturing Company, Addison, Illinois.

River gravel about ½" diameter covers the perforated plates to a depth of 3" to 4", enabling the air to diffuse evenly through the small air slots over the entire floor surface of the tank. Air is forced through the air slots on a timed cycle. The refuse is distributed to a controlled depth of 6 to 8 feet on top of the gravel for the digesting period, which is approximately six days.

5. Air System. When the oxygen content in the digester tank drops below the minimum desired per cent (usually 5%), the forced-air blower is turned on by a timing device which controls the blower. The timer provides 5 basic time ranges with a cycle change every 15 minutes. There are four operating cams, one for each section of tank. The usual air cycle is 1½ minutes on, 13½ minutes off, for each individual tank. This forces fresh air through the floor and through the digesting mass of refuse, until the optimum oxygen level is reached. The blower then shuts off until the next cycle. Cycles are determined by experience, testing when the oxygen content drops below the minimum level, at which time the cycle should be repeated. The air chambers are divided up into 20 foot sections. Each section has its own air inlet with control valve, so that air volume can be balanced over the whole system.

6. Agi-Loader. The Agi-Loader has two functions: to agitate the composting refuse in the digester tanks, and to unload the material from the tanks. The Agi-Loader was designed by Metro-Waste (Patent No. 3,294,491), and manufactured by Gulf Machinery Company, Safety Harbor, Florida, Model No. 71-11.

The machine has two basic parts: an apron conveyor 19 feet wide by 19 feet long, and a shuttle belt conveyor with folding ends. The shuttle belt is 24 inches wide by 24 feet long. It is driven by a 1½ HP motor and has a belt speed of 260 feet per minute. The apron conveyor is driven by a 7½ HP electric motor and has a constant speed of 25 feet per minute. Both conveyors are mounted on a framework which rolls on rails mounted on top of the digester tank walls. The Agi-Loader has two independent drives to move it on the rails. The forward feed drive is used for slowly moving the machine when the apron conveyor is agitating or unloading compost. This drive is a Boston "Ratiotrol" unit, manufactured by Boston Gear Works, Quincy, Mass., Series E, Model SCR. It consists of a 1 HP D.C. electric motor which is variable in speed but constant in torque output. The motor uses a rheostat-type control for the speed variation. The 1 HP motor drives a 3600-1 ratio gear reducer. The working rail speed of the Agi-Loader is from 0.30 inches per minute to 9.04 inches per minute.

The second Agi-Loader drive is called the "quick return" drive. It is used to move the machine to the end of the digester tank. The quick return drive gives a rail speed of 60 feet per minute and is driven by a 2 HP gear motor.

The apron conveyor is pivoted at the drive end or top, while the bottom can be raised or lowered using a cable-operated winch, driven by a 5 HP gear motor. During agitation, the apron conveyor is lowered into the digester until it just clears the gravel at the bottom. The Agi-Loader moves slowly forward against the compost with the apron conveyor lifting the compost out of the digester and carrying it to the top end of the conveyor where it falls back into the tank. During agitation the unloading shuttle conveyor is rolled out of the way so the compost can fall directly back into the tank.

Agitation aids digestion in several ways: it breaks up any air channels in the mass; it relieves a settling or packing condition which hinders aeration from the floor plenums, it provides additional mechanical aeration of the composting mass, and it disperses the bacteria more uniformly through the digesting mass.

To unload the digester tank using the Agi-Loader, the same process is used as in agitating except the shuttle conveyor is rolled forward to catch the compost falling from the top end of the apron conveyor. The shuttle unloading belt then conveys the compost to the tripper belt where it is carried to the digester unloading belt.

The digester tank can be filled at the same time it is being emptied using the same tripper-belt provided the tripper is located "upstream" of the Agi-Loader on the tripper belt.

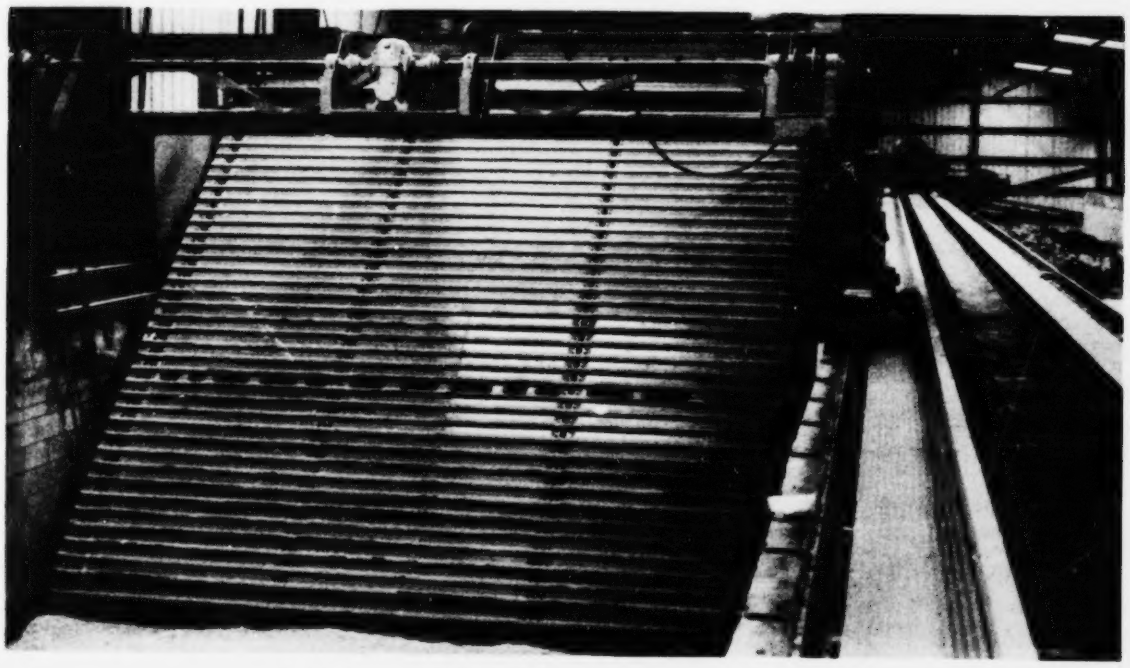


Figure 25 Agi-Loader

7. Transfer Car. The Agi-Loader was designed to travel the length of the digester tank on rails. With an interest in economy, only one machine is used for both digester tanks. The Agi-Loader can be transferred from one digester tank to the other by using a Transfer Car System at the unloading end of the digester. The transfer car is a platform which travels on rails between the digester tanks and is itself equipped with rails on which the Agi-Loader is positioned during the transfer cycle.

To move the Agi-Loader from one digester tank to the other, the apron conveyor must first be raised up out of the digester tank. Then the Agi-Loader is driven on to the transfer car, which moves the Agi-Loader to the other digester tank where it is positioned by lowering the apron conveyor into the composting material. The transfer car is driven by a 3 HP gearmotor and has a rail speed of about 45 feet per minute.

H. Finishing System.

1. Discharge Conveyor System - After the refuse has completed the digestion cycle, it is discharged from the tripper conveyor onto the Discharge Unloading Belt. This belt runs from the tripper conveyor belt underneath the transfer car rails and discharges onto the Final Grind Feed Belt. The Discharge Unloading Belt was manufactured by Gulf Machinery Company, Safety Harbor, Florida, Model No. 74-34. It is 24" wide by 35' long and is driven by a 2 HP motor giving a final belt speed of 250 feet per minute. (Figure 23, Page 40).

The Final Grind Feed Belt elevates the compost to the Grinder Feed Screw. This belt is 24 inches wide by 49 feet long, and is driven by a 3 HP motor and has a belt speed of about 250 feet per minute. The Belt and the Grinder Feed Screw were both manufactured by Gulf Machinery Company, Safety Harbor, Florida. The Belt Model Number is 74-35, and the Screw Model Number is 74-36. The Grinder Feed Screw is 16" in diameter and 24 feet long, and is driven by a 3 HP motor at 90 RPM.

From the Final Grind Screw the compost drops into two identical Grinder Metering Screws. Each of these is 12 inches in diameter and 7½ feet long, and is driven by a 1 HP motor giving the screws a speed of 110 RPM. They were manufactured by Gulf Machinery Company, Safety Harbor, Florida, Model No. 74-37 (Figure 26, Final Grind Mills, below).

Although each final grind mill is rated at 10 tons per hour, an overflow screw conveyor is provided at the end of the final grind screw to return the possible overage to the Final Grind Feed Belt.

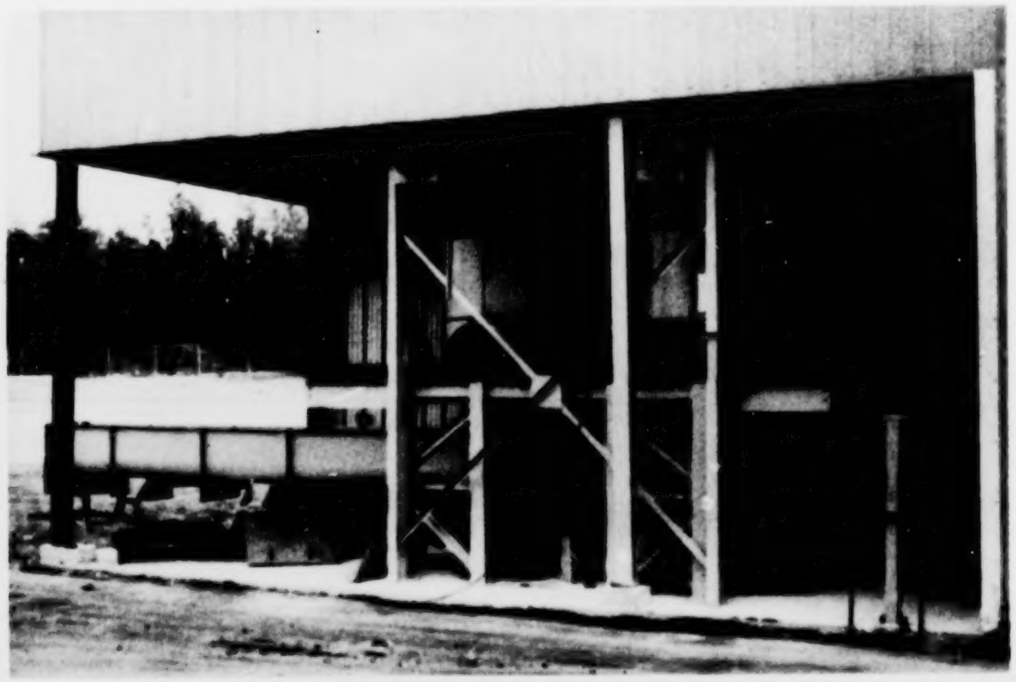


Figure 26 Final Grind Mills

2. Final Grind Mills (Figure 26, Page 46). These mills are fed at the top, and the compost is dropped into a set of fast turning horizontal swing hammers or blades, which are turned by a vertical main center shaft. The material is forced between the hammers and stationary screens which are 3' in diameter with 9/16" perforations on 3/4" centers, providing an open area of 51 per cent, which creates a shearing action. These mills are made by Dan B. Vincent, Inc., Tampa, Florida, are about 36" in diameter by 30" screen height, and weigh about 8,000 pounds. They are powered by 150 HP motors, with a shaft speed of about 960 RPM. As the compost becomes fine enough, it is discharged through the circular screen at the periphery. The regrind mills are in a vertical position and the discharge is at the bottom. The finely ground material is carried by the Grinder Discharge Screw Conveyor to the Stockpile Conveyor. The Grinder Discharge Screw is 24 inches in diameter by 20 feet long, is driven by a 5 HP motor, and rotates at about 26 RPM. It was manufactured by Gulf Machinery, Safety Harbor, Florida, Model No. 74-28.

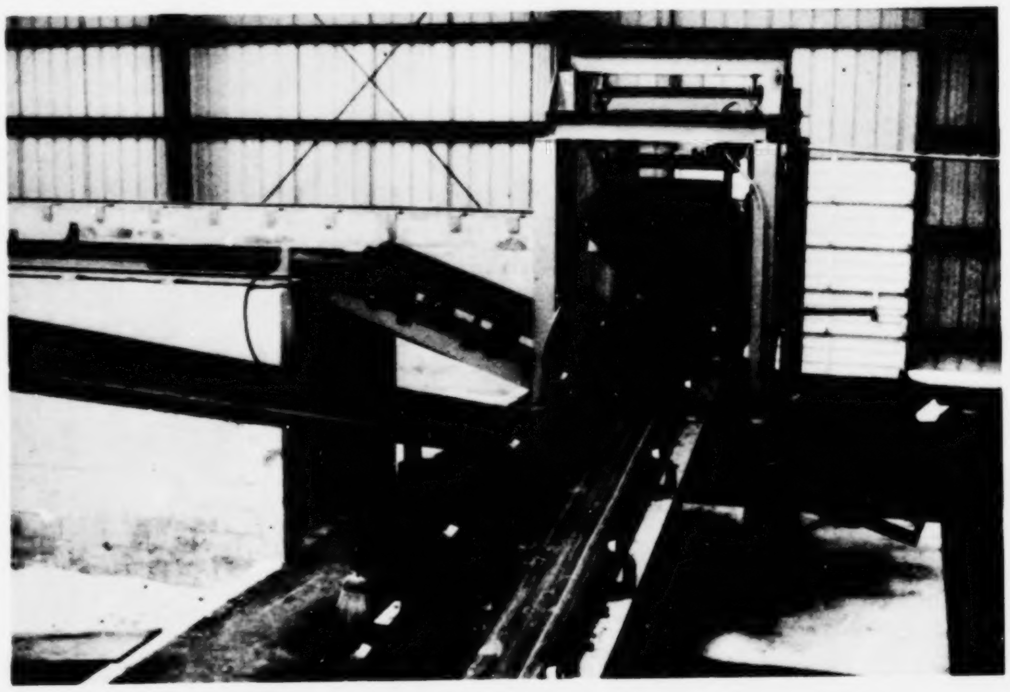


Figure 27 Delivery Conveyor from Secondary Grinder to Magnetic Separator

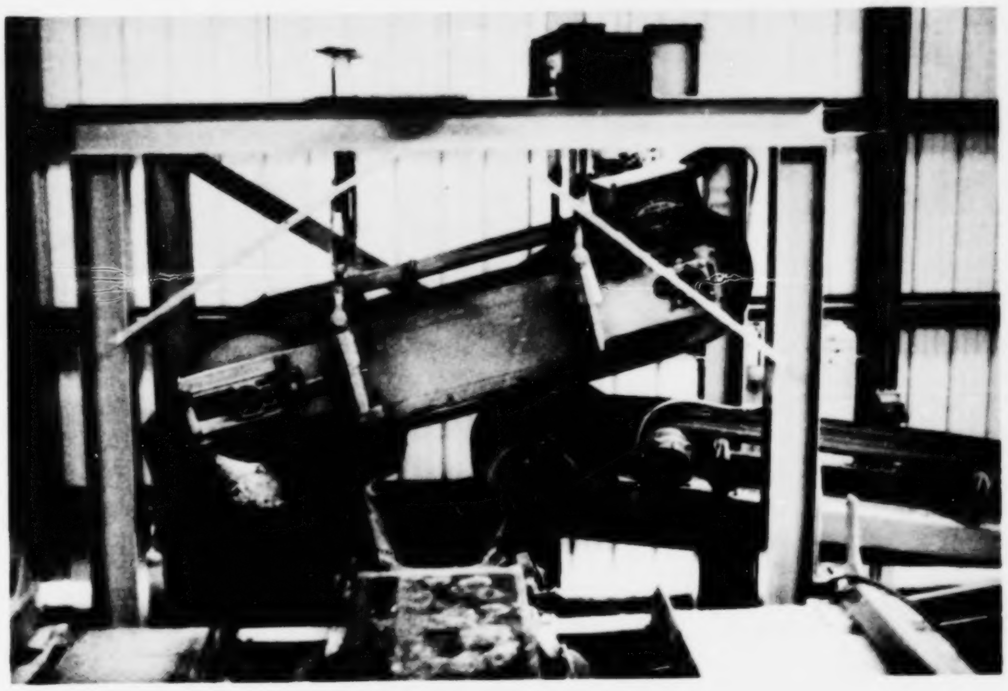


Figure 28 Electro-Magnetic-Separator

3. Stockpiling. From the Grinder Discharge Screw, the compost drops onto the Stockpile Conveyor. This Conveyor is 18 inches wide by 80 feet long, and elevates to about 35 feet above the ground at the rear of the Bulk Storage Building. As a pile is formed under the end of the belt, the

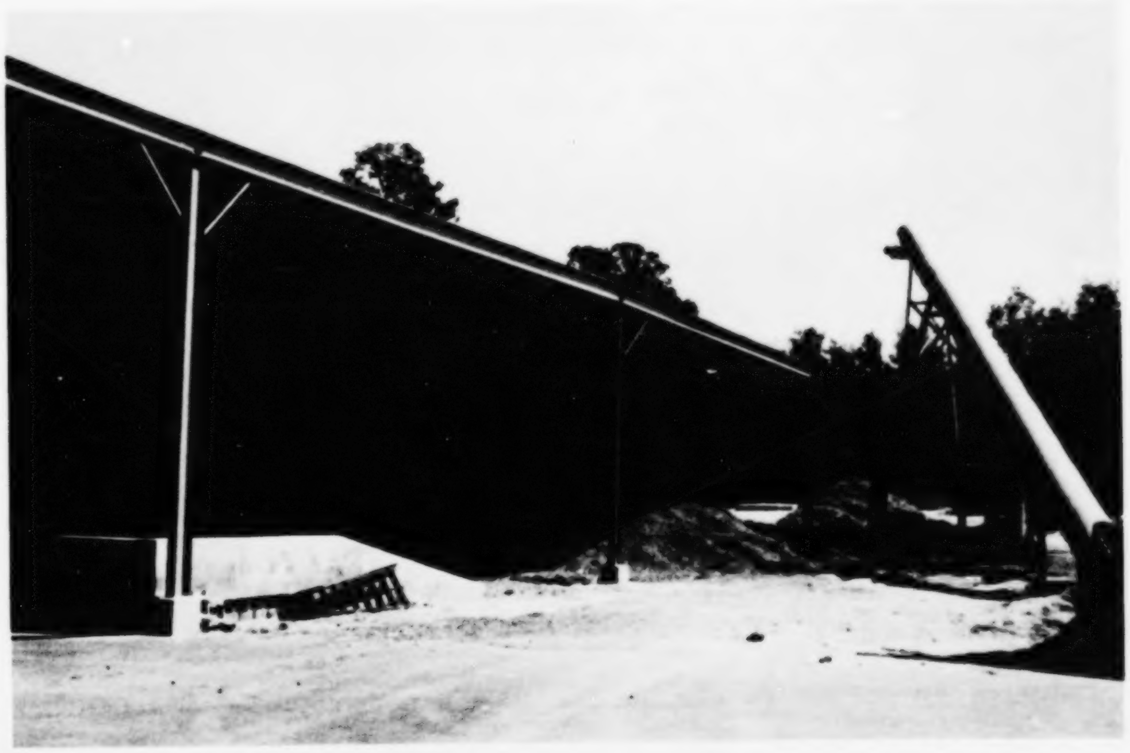


Figure 29 Bulk Storage Building and Conveyor

end-loader can carry the compost into the storage building for stockpiling or for out-loading. There is a concrete loading ramp in the building for ease of truck loading. (Figure 29, Page 48).

I. Metal Salvage System.

1. Magnetic Separator. After the material has passed through the Mixing Screw, it is fed on to a conveyor belt directed toward an electro-magnetic ferrous metal separator. (Figure 27, Page 47, and Figure 28, Page 48). This magnetic metal separator is used to separate tin cans and tramp metal from the processed refuse. In effect this is the third separation of tin cans and tramp metal from the incoming refuse. The magnetic metal separator is manufactured by Magnetic Engineering and Manufacturing Company of Clifton, New Jersey, Model No. Series SE-13, rectangular suspended, self-cleaning. This company is a division of Eriez Manufacturing Company, Erie, Pennsylvania. Magnet size is 30 inches wide, 45 inches long and 24 inches high and the overall size of the complete magnetic metal separator is 8 feet 6 inches long by 5 feet wide.

The magnet of this magnetic metal separator is placed between two pulleys with a small belt conveyor encircling both the pulleys and the magnet. Inline type units are inserted at the discharge of the head pulley in the system. The magnetic metal separator parallels the trajectory, automatically removing and discharging tin cans and tramp metal. The belt moves the metal from the magnetic field and drops it into a chute leading onto the tin can and tramp metal conveyor. The cleaned refuse is fed onto the Tripper belt Conveyor.

2. Metals Conveyor. After the metal drops off the magnetic separator, it is transported on out to the Burner by a Can Conveyor. The Can Conveyor is

made in two sections. The first section elevates the material from the magnetic separator to the second section which also receives the metal from the upper conveyor in the Ballistic Separator. The first can conveyor is 12 inches wide by 48 feet long, is driven by a 2 HP motor, and has a belt speed of 102 feet per minute. The second conveyor is 16 inches wide by 40 feet long. It conveys metal from the 12 inch belt and the ballistic separator upper discharge belt to the stainless steel Burner Belt Conveyor. The 16 inch belt is driven by a 2 HP motor and has a speed of 102 feet per minute. Both Can Conveyors were manufactured by Gulf Machinery Company, Safety Harbor, Florida. Model numbers are: 16 inch belt, 74-28; 12 inch belt, 74-31.

3. Burner Conveyor. The metal falls from the Can Conveyor onto a 24 inch wide, type 309 stainless steel woven belt conveyor. This belt is 18 feet long and travels at 3 feet per minute through the Burner, where the cans and miscellaneous metals on this belt are heated to at least 1800°F. This burns away the unwanted debris, including garbage, paper, glue, tin, solder and any other contaminants in the metal. This conveyor is manufactured by Gulf Machinery Company, Safety Harbor, Florida, Model Number 76-80, and is powered by a 1/3 HP gearmotor.

4. Burner. (See Figure 30, Burner, Page 51). The Burner is a vertical type heater manufactured by Dan B. Vincent, Inc., Tampa, Florida. It is 9 feet, 6 inches diameter and approximately 35 feet high, and is lined with high temperature refractory brick. The refractory was manufactured by The A. P. Green Fire Brick Company, Mexico, Missouri. It was installed in the burner by A. P. Green Services Division of Bigelow-Liptak Corporation, Detroit, Michigan. The refractory consists of two types; one is prefired bricks, and the other is monolithic or plastic which is molded into shape. Both types are guaranteed to withstand 3000°F. temperatures.

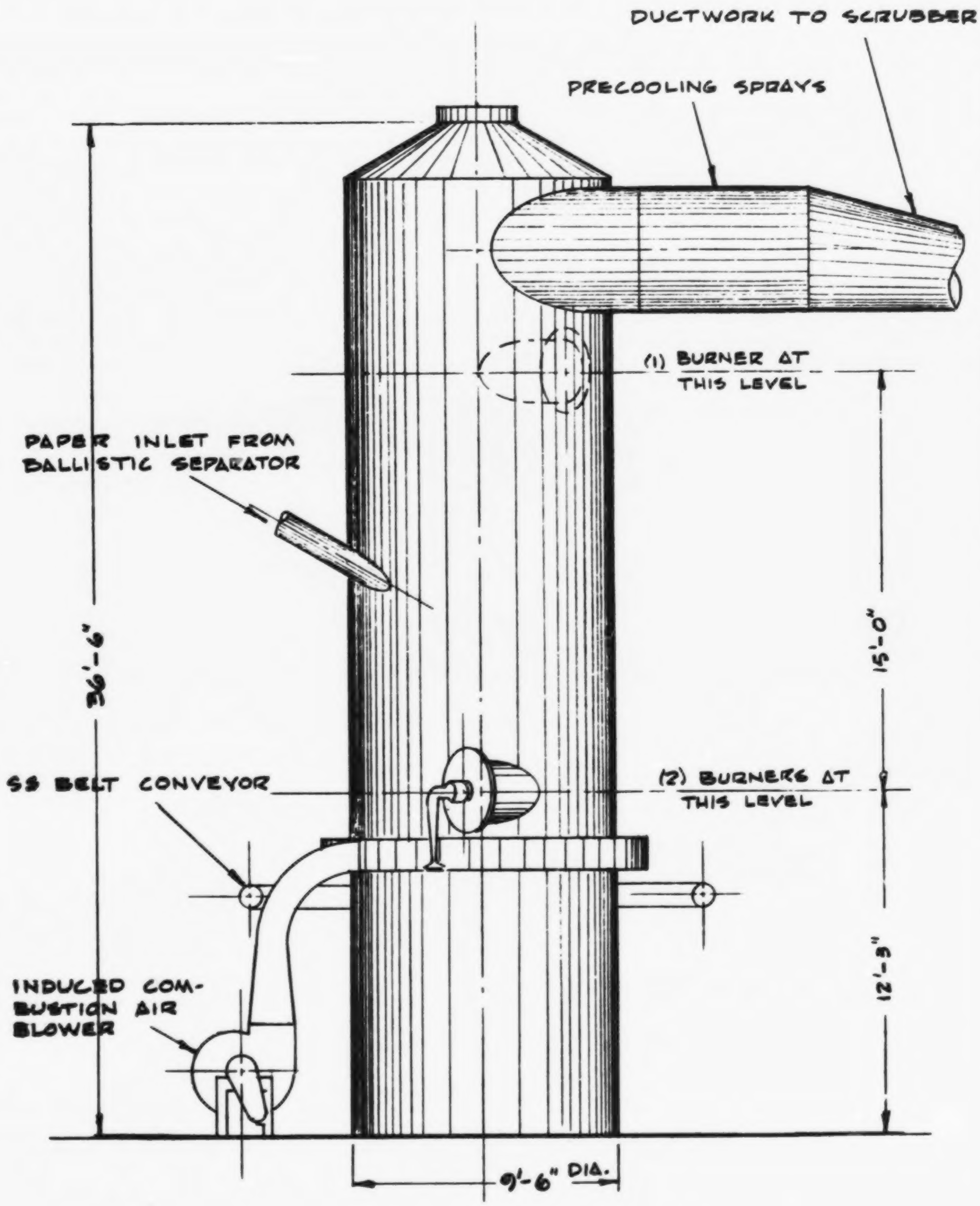

DUCTWORK TO SCRUBBER
PRECOOLING SPRAYS
(1) BURNER AT THIS LEVEL
PAPER INLET FROM BALLISTIC SEPARATOR
36'-6"
15'-0"
SS BELT CONVEYOR
(2) BURNERS AT THIS LEVEL
12'-3"
INDUCED COMBUSTION AIR BLOWER
9'-6" DIA.

FIGURE 30
BURNER

The refractory is brought up to operational temperatures by three Venturi inspirator-type gas burners made by Maxon Premix Burner Company, Muncie, Indiana. After refractory has reached proper temperature (about 1800°F.), paper removed from the Ballistic Separator by its two blowers is blown into the Burner through a pipe in the side wall located about 20 feet above the ground. The paper volume to be handled is expected to be about five tons per hour. The injected paper will be the primary source of fuel for the Burner, so the gas burners can then be turned down, and probably one at low pressure would be enough to keep the paper ignited. Disposal of surplus paper in this manner helps attain the desired carbon-nitrogen ratio necessary for proper composting, and the Burner also provides an excellent means for the disposal of film plastics which are easily removed by the Ballistic Separator air system, and are a contaminant in the compost if not removed.

When a substantial volume of paper and plastic is being injected into the burner for combustion, sufficient air is not available from simply the incoming stream and from the Venturi burner openings. Therefore, an induced combustion air blower (Figure 30, Page 51) has been added to the burner complex, to increase the volume of air injected into the furnace during periods of heavy burning. The air to be injected is led from the blower, having a capacity of 1900 CFM, to a circular plenum surrounding the lower part of the combustion chamber, and enters the combustion chamber through six holes behind the plenum. The holes are equally spaced, and are placed at an angle to increase the swirl effect of the gases inside the combustion chamber.

5. Exhaust Gas Scrubber System (Figure 31, Page 53). All gases exhausted from the Burner will first be cooled to approximately 600°F. by water sprays in the duct-work. The gases then pass through a wet scrubber, manufactured by Western Precipitation Group of Joy Manufacturing Company, Los Angeles,

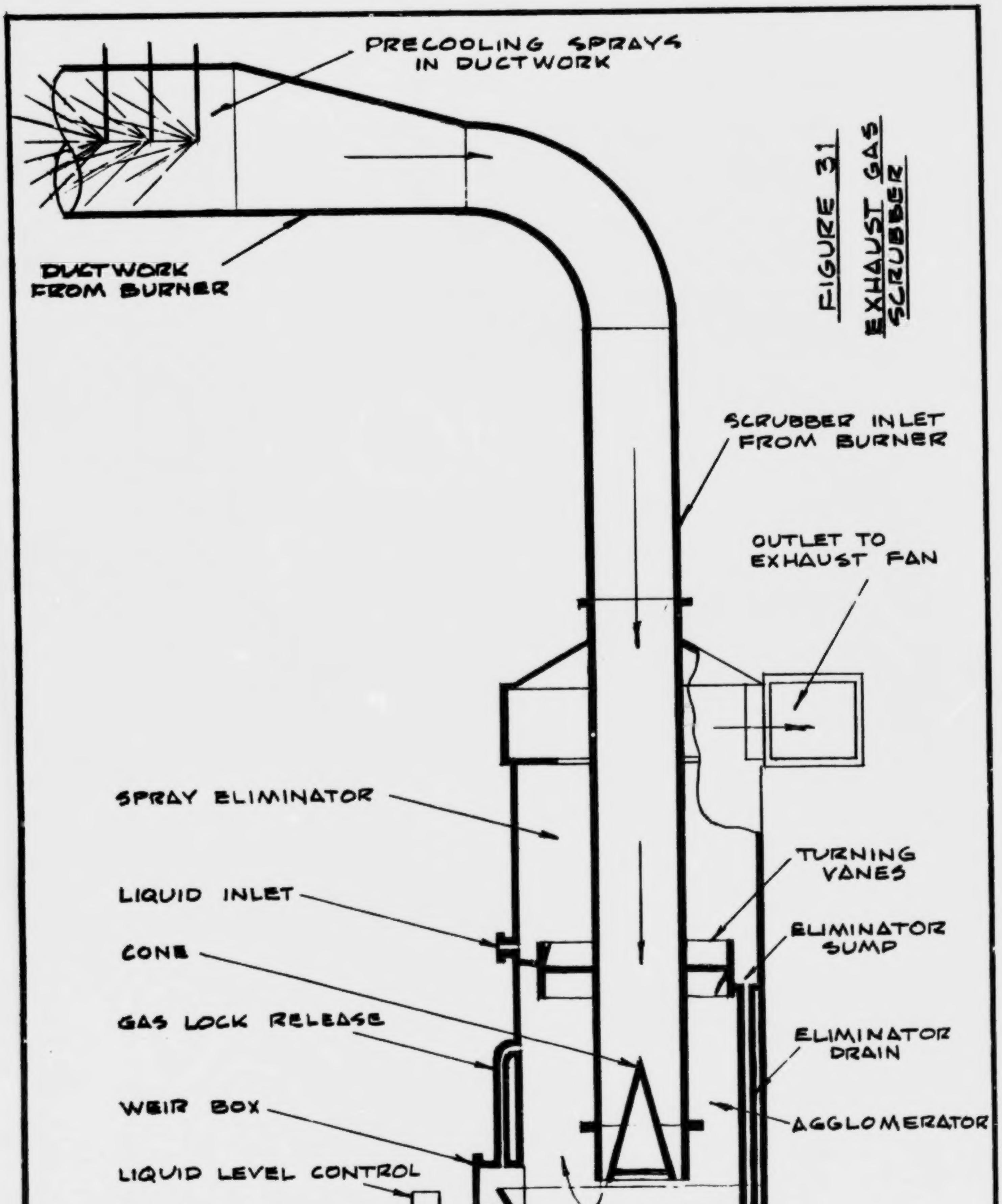


FIGURE 31
EXHAUST GAS SCRUBBER

PRECOOLING SPRAYS IN DUCTWORK
DUCTWORK FROM BURNER
SCRUBBER INLET FROM BURNER
OUTLET TO EXHAUST FAN
SPRAY ELIMINATOR
TURNING VANES
LIQUID INLET
ELIMINATOR SUMP
CONE
GAS LOCK RELEASE
ELIMINATOR DRAIN
WEIR BOX
AGGLOMERATOR
LIQUID LEVEL CONTROL
SURGE TANK
PUMP TO SLUDGE TANK
OVERFLOW PIPE

California. The model is designated as a Turbulaire Unit, Type C-B, size 16. This unit was selected to handle an initial volume of 40,000 CFM at 1600°F. which, as mentioned above, will have been cooled to 600°F.

The water requirement for this pre-cooling is about 18 gallons per minute. The 600°F. gases are further cooled within the scrubber, with a resultant outlet gas volume of 19,000 CFM at 180-200°F. An additional 22 GPM of water will be required in the scrubber of which 12 GPM will be evaporated and the remaining 10 GPM will be used to transport the collected dust in the form of a slurry to the sludge tank. The scrubber is guaranteed for outlet emissions not to exceed 0.04 grains/SCF with an inlet dust load of 2 grains/SCF, with the scrubber operating at 5 to 7 inches water column pressure drop. This performance standard will satisfy State and County air pollutant emission standards.

Fundamentally, the scrubber works by bubbling the contaminated gases through water where the dust is entrained and the clean gases exit the scrubber. Air is drawn through the Burner and the Wet Scrubber by a centrifugal air handling fan. The fan was manufactured by Sheldons Manufacturing Corp., Bensenville, Illinois. It is a size 29 Industrial fan, Type XB air wheel. The fan was sized for 19,152 CFM at 10 inches water column static pressure. The horsepower requirement is 42.2 HP at 887 RPM. A 60 HP motor will be used to have a safe overload factor in the event of having to speed up the fan. Sampling ports will be installed in the ductwork just before the Scrubber, and in the exhaust stack after the fan.

6. Metal Pelletizer. (Figure 32, Page 55). After the metal has been burned, it falls into the metal pelletizer. The metal pelletizer is a Model CM-300-S Noll Mill. It was manufactured by Noll Engineering Company, Rolling Meadows,

Figure 32 Burner, Metal Pelletizer and Metal Storage Bins

Illinois. The mill capacity is rated at 800 pounds per hour of pre-hammermilled tin cans. It is driven by a 30 HP, 1800 RPM electric motor through a V-belt drive, giving a final rotor speed of 3400 RPM.

The physical appearance and operating principle of the Noll Mill closely follows that of a very heavy duty centrifugal fan. The most major difference is a 4-section removable liner with perforated holes, the holes in the present segments being 1". The size of holes can be varied by replacing the sectional impact segments. The liner is about 1/4" in diameter larger than the six rotor blades. The burned metal cans are discharged through an 8" x 8" opening on the front face of the mill housing directly in the center of the high speed rotor. The metal is then sheared between the rotor blades and the perforations in the liner. The pellets discharge through the bottom of the housing onto a cleated belt conveyor which transports them to a ferrous metal separator.

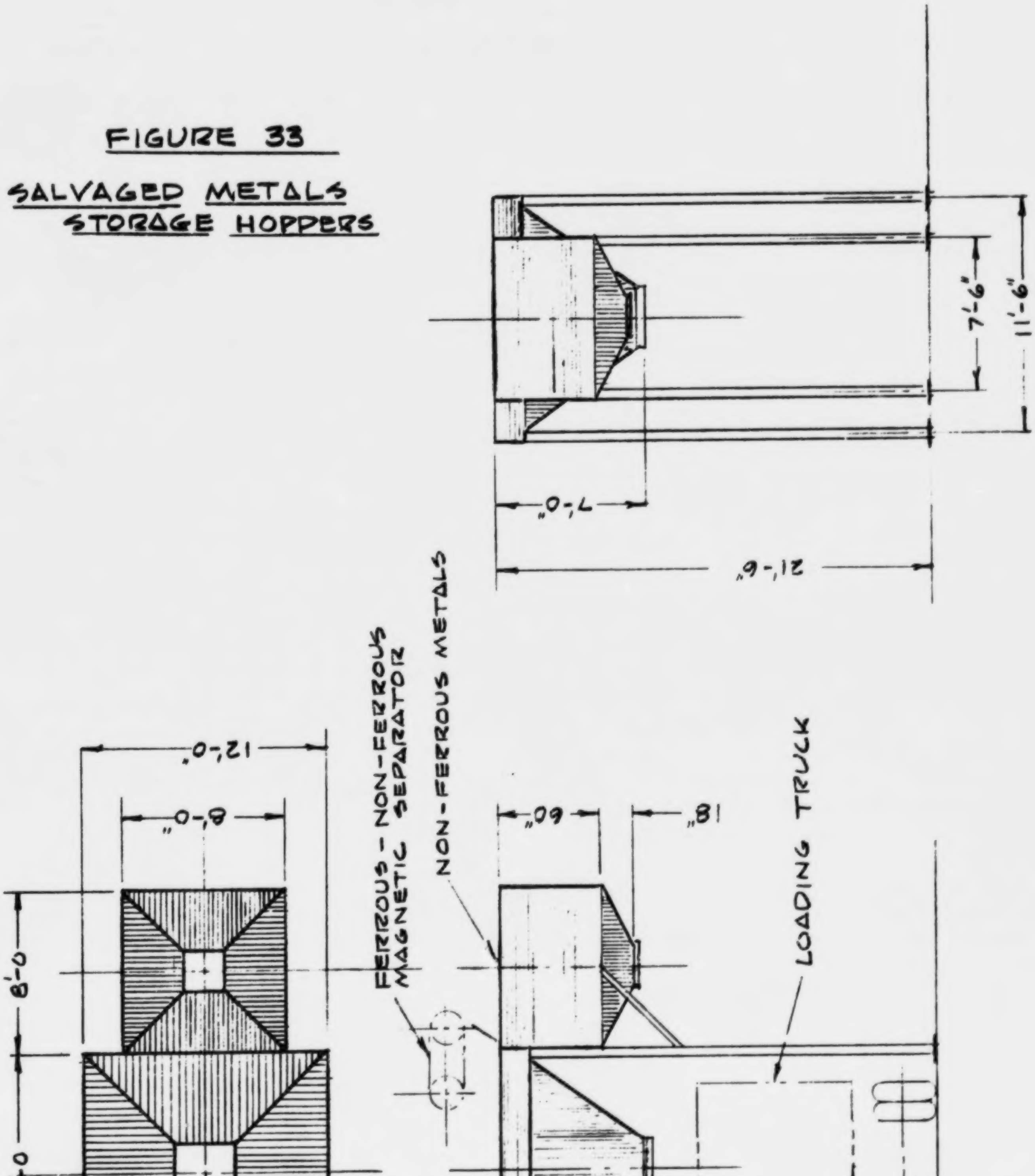
The reduction of the cans in size is from approximately 2" x 2" to about 1/2" x 1/2" pellets. The metal in pelletized form has a substantial bulk density which reduces storage requirements and facilitates handling. It also gives a uniform appearance and ease of shipping which will facilitate marketing.

7. Ferrous Metal Separator. The metal discharges from the Noll Mill onto a cleated belt and is conveyed to a permanent magnet separator. This belt is 18 inches wide by 45 feet long and is driven by a 2 HP motor. Final belt speed is about 250 feet per minute. It was manufactured by Gulf Machinery Company, Safety Harbor, Florida, Model Number 77-8. This ferrous - non-ferrous metals separator consists of a short belt conveyor with a permanent magnet head pulley. As the ground metal passes over the magnetic head pulley, the ferrous metal clings to the magnet and is carried on around with the belt, and drops off into the ferrous metal hopper. The non-ferrous material is projected off the end of the belt by ballistic action into the non-ferrous hopper. This magnetic separator was manufactured by Gulf Machinery Company, Safety Harbor, Florida, Model Number 79-11. It is powered by a 2 HP motor and travels at about 250 feet per minute.

8. Salvage Metals Storage Hoppers. (Figure 33, Page 57). As the ferrous and non-ferrous metals are separated by the permanent magnetic separator, they fall into two separate storage hoppers. These hoppers were manufactured by Gulf Machinery Company, Safety Harbor, Florida. The larger ferrous metal hopper holds approximately 576 cu. ft. of pelletized metal. The smaller non-ferrous metal hopper holds about 384 cu. ft. Both hoppers are equipped with dropout doors operated with cable winches. The hoppers are high enough from the ground to allow trucks to drive under for loading.

FIGURE 33

SALVAGED METALS STORAGE HOPPERS


12'-0"
8'-0"
60"
18"
7'-0"
21'-6"
7'-6"
11'-6"
8'-0
12'-0
FERROUS - NON-FERROUS MAGNETIC SEPARATOR
NON-FERROUS METALS
LOADING TRUCK
FERROUS METALS
TOP VIEW

J. Equipment Specification Table. A detailed 5-page specification table, showing description, supplier, horsepower, RPM, capacity, and other information has been prepared for all major items of machinery and equipment of the plant, and is included in this report as Appendix A.

V. CONSTRUCTION OF PLANT AND COSTS

A. Construction of Plant. Construction of the plant began on March 27, 1967, and has proceeded steadily since that date. Construction involved first clearing off a dense stand of scrub timber and a very thick undergrowth, and levelling the site. In excavating for foundations, a spring was encountered which necessitated the installation of a separate drain tile. During construction, a number of periods of exceptionally heavy rainfall occurred, which severely hampered some phases of construction. However, the soil of the site is basically sand, which did allow for a rapid runoff. Construction of the plant proceeded in basically the following sequence:

1. Site preparation
2. Office building foundations and construction
3. Plant building foundations
4. Erection of main building
5. Construction of digesters
6. Plumbing and sheet metal work
7. Machinery foundations
8. Installation of plant machinery and equipment
9. Electrical installations
10. Sewage sludge handling facilities
11. Scale installation
12. Final grading and road installation

13. Bulk Storage building and conveyor.
14. Burner and metal salvage processing system.

The construction of the plant has been carried out by subcontractors, selected on the basis of bids taken on the plans and bidding specifications prepared by the consulting engineers for the Project, and under the general direction and supervision of Metropolitan as general contractor.

B. Cost of Plant. Construction of the plant has been virtually completed as of the close of 1967. The buildings are complete and all machinery has been completely installed through the finish grinders, except for the metals salvaging system, including conveyors, burner, metal pelletizer, and cyclones and air pollution control equipment. Electrical installations are virtually completed, and all conveyors and machinery now in place have been turned over and tested under their own power. The cost of the principal components of the plant, including shipping and installation, are approximately as follows:

1. Land and land improvements and site preparation, including site clearing, grading, black top paving, drain tile, fence, etc.	$105,162
2. Buildings:	
a. Office and Laboratory Building	23,124
b. Plant Building	107,455
c. Bulk Storage Building *	13,400
3. Machinery and Equipment:	
a. Receiving System:	
(1) Truck scale	21,972
(2) Receiving ramp, wells and drive	48,640
(3) Apron conveyor	30,745
(4) Oscillating conveyor	10,192
(5) Picking belt	13,236
(6) Picking platform and control tower	25,878

b. Paper salvage system:	
(1) Baler	8,006
(2) Conveyors	10,667
c. Grinding system:	
(1) Crusher-disintegrator	68,864
(2) Ballistic separator	23,488
(3) Secondary hammer mill	21,062
(4) Conveyors	12,133
d. Sludge handling system:	
(1) Mixing screws	2,981
(2) Sludge storage tank	12,200
(3) Sludge pump and drive	2,140
(4) Automatic sensors and controls	7,000
(5) Sludge aerating blower	378
e. Digester system:	
(1) Tripper belt conveyor	13,815
(2) Tripper with unloading shuttle belt conveyor *	3,139
(3) Digesters including air system *	40,535
(4) Agi-loader and transfer car	39,664
(5) Conveyors and instrument program **	27,833
f. Finishing system:	
(1) Final grinders	24,992
(2) Conveyors and other equipment *	19,184
(3) Stockpile Conveyor *	5,242
g. Metal salvage system:	
(1) Magnetic separator *	5,666
(2) Burner	26,736
(3) Noll metal pelletizer	6,860
(4) Ferrous-non ferrous metal separator	896
(5) Storage bins with dropout doors	6,575
(6) Conveyors	14,332
4. Electrical *, Plumbing, heating and air conditioning	164,422
5. Erection and installation of machinery and equipment:	
a. Supplies and services	54,746
b. Labor and payroll expenses	125,000
c. Supervision and sundry expenses	55,000

6. End Loader	18,282
7. Fork Lift	7,106
8. Station Wagon	3,472
9. Tools *	7,239
10. Supplies - baling wire	2,355
11. Office and laboratory:	
a. Office equipment and furnishings	3,155
b. Office supplies	2,080
c. Laboratory equipment and furnishings	11,391
d. Laboratory supplies	2,939
12. Consultants:	
a. Engineering, design and inspection * * *	64,092
b. Technical	13,902
13. General and administrative expense	47,150
	1,386,523

* The Authority has been able to use some items of used equipment in the construction of the plant, these items (as marked above with *) including electrical switch gear, electrical motors, some blowers, belt conveyors, auger conveyors, scale, steel rail, storage bin, tripper, electro-magnet, some tools and storage building. The cost of these items to the project was $53,153, and the approximate saving to the project for these items, over new cost, was $20,500.

* * Includes approximately $15,600.00 for Mobile Instrument Console, Honeywell, Inc.

*** (City and County inspection personnel and the Project Director also assisted in performing inspection functions.)

VI OPERATIONAL PHASE OF PROJECT

The operational phase of the project will commence soon after the start of the new year. This phase will consist of the following steps:

A. Preliminary Equipment Testing. Each individual piece of equipment will be run for an extended period without load, to insure proper functioning of all components, including bearings, gears, belts, mountings, power, etc. Then each individual piece will be tested under light loads, gradually increasing to the full normal load. During this phase of testing, the Public Participants in the Project have agreed to deliver refuse by the truckload as scheduled.

B. Start-up of Normal Operations. It is expected that the normal operations will commence about the end of the first quarter of the new year. Consultations have been held with all of the Public Participants, and all prepare to move into this phase on relatively short notice.

C. Personnel. It is expected that a working force of 25 persons will be utilized to operate the plant, this force including 4 office and management-level personnel, 8 machine operators, 5 maintenance personnel and 8 utility classification personnel. These persons, and the duties of each, are set out in a Table of Organization, Figure 34, Page 63 following. A Personnel Chart of Plant Personnel has also been prepared, in which the position, duties and basis and rate of compensation of all personnel are set forth. This chart has been included in this Report as Appendix B.

D. Training of Personnel. This is a phase of the Project very critical for the overall success. Several key personnel have been given training at the Houston

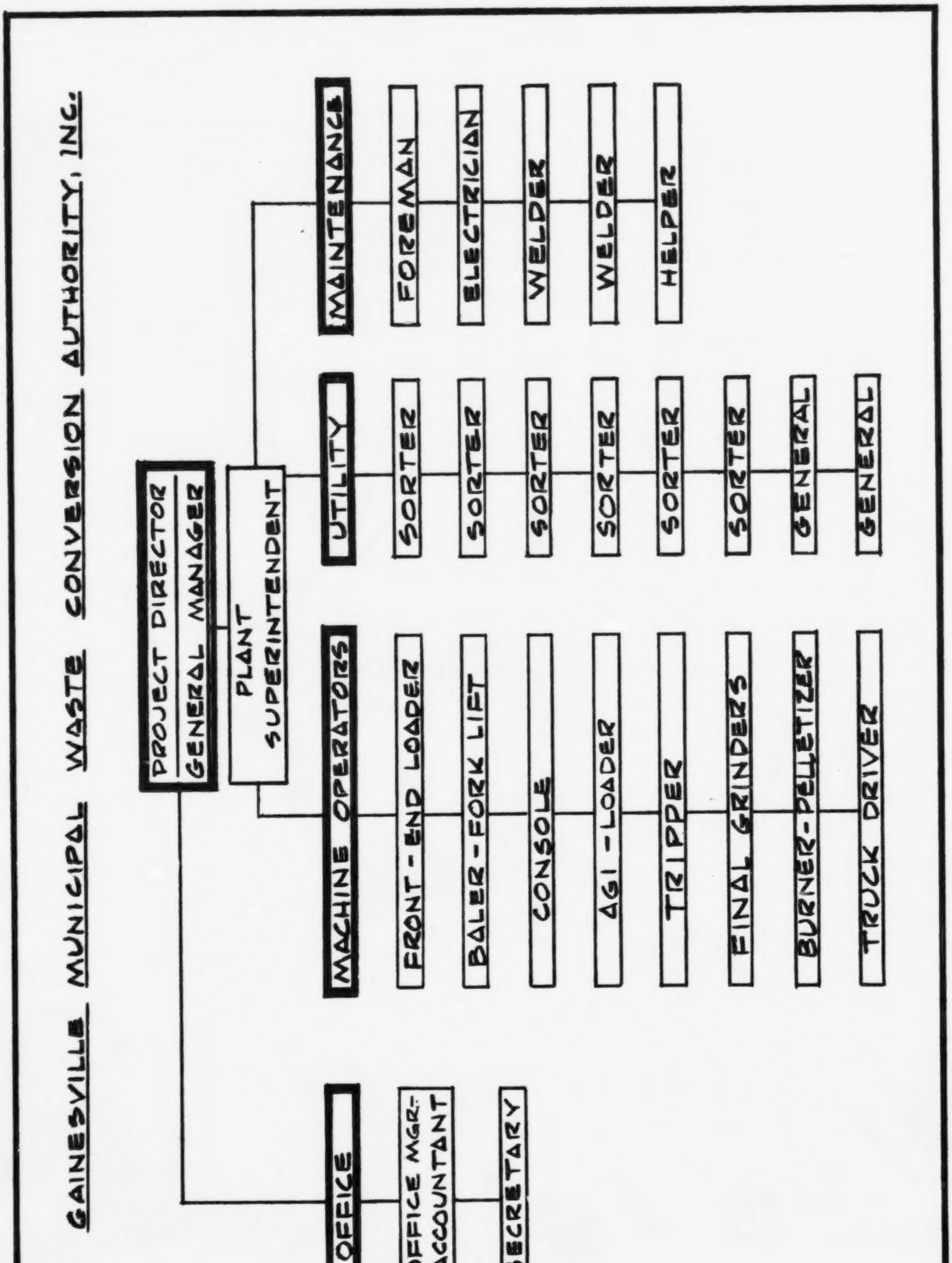

GAINESVILLE MUNICIPAL WASTE CONVERSION AUTHORITY, INC.
PROJECT DIRECTOR
GENERAL MANAGER
PLANT SUPERINTENDENT
OFFICE
OFFICE MGR.-ACCOUNTANT
SECRETARY
MACHINE OPERATORS
FRONT-END LOADER
BALER-FORK LIFT
CONSOLE
AGI-LOADER
TRIPPER
FINAL GRINDERS
BURNER-PELLETIZER
TRUCK DRIVER
UTILITY
SORTER
SORTER
SORTER
SORTER
SORTER
SORTER
GENERAL
GENERAL
MAINTENANCE
FOREMAN
ELECTRICIAN
WELDER
WELDER
HELPER

FIGURE 34 Table of Organization, Plant Personnel

plant of Metropolitan, and a number of personnel employed in the construction of the plant were selected to become part of the permanent operating labor force. As the plant builds up toward full normal operation, the labor force will be built up to full operating strength. Special training and supervisory personnel will be supplied by Metropolitan to insure that all personnel are adequately instructed in their respective duties and responsibilities. However, beyond this instruction, it is anticipated that a period of time will be essential for the labor force to gain the experience necessary for effective day-in, day-out long-run operation of the plant.

E. Plant Management and Operations Procedures. A regular program of plant maintenance has been prepared, including the following:

(1) Inspection and Lubrication Procedure. A regular schedule of inspecting and lubricating all operating equipment has been established, and charts covering all equipment have been prepared. A copy of Page 1 of this Schedule is attached hereto as Figure 35, Page 65.

(2) Equipment Repair and Maintenance Cost Control. An Evaluation Control Report form showing repair and maintenance costs of principle equipment has been prepared and will be kept for principle items of equipment. A copy of this Evaluation Control Report form follows as Figure 36, Page 66.

(3) Analysis of Operating Costs. A form of operating report by principle plant operating sections has been prepared, whereby it is expected to establish the per-ton operating costs of the principle operating sections of the plant. The sections of the plant for which this cost analysis is expected to be kept will include the following:

GAINESVILLE MUNICIPAL WASTE CONVERSION AUTHORITY, INC.

INSPECTION AND LUBRICATION SCHEDULE

	EQUIPMENT	CYCLE	MONTH	MONTH	MONTH
	Apron Conveyor				
	(a) Head Pulley	Weekly			
	(b) Tail Pulley	Weekly			
	(c) Drive Motor	6 Months			
	(d) Gear Box	6 Months			
	(e) Drive Chain	Weekly			
	(f) Takeup Drive	Weekly			
	(g) Bearing Blocks	Weekly			
	Vibrating Conveyor				
	(a) Motor	6 Months			
	(b) Bearing Blocks	Weekly			
	(c) Drive Shaft	Weekly			
	Compressor				
	(a) Motor	Monthly			
	(b) Oil Crankshaft	Weekly			
	(c) Clean Filter	Weekly			
	(d) Drain Water	Weekly			

FIGURE 35 Inspection and Lubrication Schedule (1st page)

EVALUATION CONTROL REPORT
EQUIPMENT REPAIR AND MAINTENANCE COSTS

Date: ____________________

Grinders and Hammers	Hammer Rebuilding							Tons Proc. since last reblt	Other Grinder Repairs			
	Removal Time	Type Rod	Lbs. Rod	Cost /Lb.	Total Rod Cost	Weldg Hours	Total Cost		Item	Part Cost	Hours	
1. Primary Grinder												
2. Secondary Grinder												
3. Final Grinder #1												
4. Final Grinder #2												

Other Equipment	Down Time	Description	Parts Cost	Repair Hours	Total Cost
5. Apron Conveyor					
6. Vibrator Conveyor					
7. Ballistic Separator					
8. Tripper					
9. Agi-Loader					
10. Burner System					
11. Sludge Equipment					
12. Conveyor (Name)					
13. Motor (Location)					
14. Motive Equipment (Name)					
15. Other Equipment (Name)					

Remarks:

Signed: ____________________

Approved: ____________________

FIGURE 36 Evaluation Control Report

1. Receiving
2. Sorting and salvage baling, etc.
3. Primary and secondary grinding
4. Metal salvage processing and handling
5. Sludge receiving and handling
6. Digesting
7. Finish grinding and handling
8. Office and general

A form whereby labor, repairs and other operating expenses can be classified according to the above operating sections has been prepared. Copies of Page 1 and summary page of this Monthly Analysis Report are attached hereto as Figures 37A and 37B.

F. Product Marketing. An important part of the operating phase of the Project is a thorough study of the marketing potential for products generated at the plant through conversion of the refuse received, into both the salvage materials and the compost product. A contract has been entered into between the Authority and Metropolitan for purchase of the entire compost product of the plant for 80% of the net sales income realized by Metropolitan from the resale thereof, but not less than $4.00 per ton bulk (dry weight basis).

1. Salvage Materials. The principal salvage items will include the paper, ferrous metals, non-ferrous metals, textiles and glass. Initial markets now exist for the paper and ferrous metal within a reasonable delivery range of the plant, but it is felt that a careful market survey, and perhaps cooperative programs with the industries involved (such as a program now under discussion with the Glass Container Institute of Washington, D.C.) will develop additional markets of increased value for these materials.

GAINESVILLE MUNICIPAL WASTE CONVERSION AUTHORITY

OPERATIONS EXPENSE ANALYSIS REPORT

Percent of fiscal year expired ______% Month of ____________________

			THIS MONTH		YEAR TO DATE		
	HRS	YTD	Ton rate	Amount	Ton rate	Amount	% Bgt.
RECEIVING:							
Operations:							
Labor - ST							
Labor - OT							
Payroll expenses							
Total labor							
Supplies - end loader							
Maintenance:							
Labor - ST							
Labor - OT							
Payroll expenses							
Total labor							
Supplies and materials							
Mat. & service - end loader							
Mat. & service - truck scale							
Mat. & service - apron conveyor							
Total receiving							
SORTING AND SALVAGING:							
Operations:							
Labor - ST							
Labor - OT							
Payroll expenses							
Total labor							
Supplies - baling wire							
Maintenance:							
Labor - ST							
Labor - OT							
Payroll expenses							
Total labor							
Supplies and materials							
Mat. & service - picking belt							
Mat. & service - collector con.							
Mat. & service - baler							
Total sorting and salvaging							
INITIAL GRINDING:							
Operations:							
Labor - ST							
Labor - OT							
Payroll expenses							
Total labor							
Electricity							
Supplies - welding							
Maintenance:							
Labor - ST							
Labor - OT							
Payroll expenses							
Total labor							

FIG. 37A Monthly Operations Analysis Report (First Page)

GAINESVILLE MUNICIPAL WASTE CONVERSION AUTHORITY

OPERATIONS EXPENSE ANALYSIS REPORT

Percent of fiscal year expired ________% Month of ________________

			THIS MONTH		YEAR TO DATE		
	HRS	YTD	Ton rate	Amount	Ton rate	Amount	% Bgt.
SUMMARY OF OPERATIONS:							
Labor - ST							
Labor - OT							
Payroll expenses							
Total labor							
Travel							
Telephone							
Electricity							
Other Utilities							
Insurance							
Supplies and materials (not repairs)							
Materials and services (repairs)							
Other services							
Equipment rental							
Equipment - new items							
Construction of facilities (new							
Land improvements (new)							
Miscellaneous							
Total expenditures							
Credits							
Net expenditures							

FIG. 37A Monthly Operations Expense Analysis Report (Summary Page)

2. Compost Materials. While it is expected that, in the normal course of operations, the basic compost product as generated at a compost plant will be sold in bulk, there is a very wide range of more sophisticated products which can be manufactured from the basic material, by the use of additives, blending, further grinding, granulation, etc. It is presently felt that this is a field which should be left primarily to the established manufacturers of fertilizing and blending materials, who have already well established sources of supply, manufacturing procedures and processes, existing plants, existing sales organizations and channels of distribution. However, it is felt that a careful market survey with these prospective users will develop areas and means by which the basic bulk product can be digested and processed at the compost plant so as to make it of optimum value for these additional uses, thus substantially increasing the ultimate outlet. Additionally, through the cooperation of the Agricultural Experiment Station Organization of the University, the Project will have the capability of experimentation and research over a very wide segment of Florida soils and Florida agriculture, to determine what kind of additives, what kind of variations in the composting process, etc., may help to make the product of greater use and therefore of greater marketability for the general agricultural market.

G. Evaluation Procedures. A major thrust for the operational phase of the Project is intended to be a thorough evaluation of all aspects of the Project, including the principal items of equipment and the various individual processes of the entire refuse conversion system, such as the paper salvage system, the metal salvage system, the textile salvage system, the digesting system, the sewage sludge handling system, the finishing system, etc. A system of reports for keeping adequate records of the performance of all principal items of equipment (Figure 36, Evaluation Control Report, Page 66) and for keeping a record of the operating costs in each principal section of the plant (Figures 37A and 37B, Monthly Operations Expense Analysis Reports, Pages 68 and 69) will provide basic information to serve as a foundation for this evaluation procedure. In addition, of course, general performance records relating to hours of service, tonnages processed, etc. will be maintained, to further assist in this evaluation procedure.

VII TECHNICAL PROGRAM OF THE GAINESVILLE COMPOST PLANT

The technical program for the calendar year 1967, involved primarily the establishment of sampling and testing protocol, equipping the microbiological and chemical laboratories, and the development of process control equipment. Some preliminary bacteriological tests were conducted in conjunction with this developmental work and the employee health program and arthropod and rodent control program were initiated. The progress of the technical program to date and the various phases of the program are reported in the following sections.

A. Facilities and Equipment. The facilities for conducting the chemical and microbiological studies associated with this program include a combination chemistry and bacteriological laboratory and special in-plant equipment for monitoring several of the factors which influence the composting process and the quality of the final product.

1. Laboratory. A combination chemistry-bacteriological laboratory is located on site in the compost plant office building. This laboratory has

about 360 sq. ft. of floor space and is fully equipped for all of the chemical analyses and all routine bacteriological studies proposed in the demonstration and quality control program. Figure 38, Page 73, shows a floor plan of the laboratory and the location of the major pieces of equipment. A description of the major laboratory equipment is presented in Appendix C.

The laboratory is staffed by one full-time technician and three part-time graduate students from the University of Florida, one each to direct the chemical, bacteriological, and arthropod and rodent control programs.

2. Process Control and Special Studies Equipment. The compost plant is equipped so that the moisture content of the ground raw refuse and the temperature of each batch of compost in the digester tanks are continuously monitored. In addition to the continuous monitoring equipment, a special mobile instrument package was developed by Honeywell, Inc. to measure the temperature, dew point, O_2 content, and CO_2 content at several levels anywhere in the digester tank and also to measure the volume of air entering a segment of the digester tank. (See also Page 75.)

3. Moisture Sensor. The moisture content of the ground refuse is measured as a function of the conductivity between two sensing electrodes in an A.C. bridge circuit. The signal generated by this circuit is calibrated in terms of moisture content and is recorded on a circular chart recorder.

The sensing electrodes consist of two metal shoes 1¼ inches wide and 4½ inches on center. These sensors are on a pivoted arm that rides

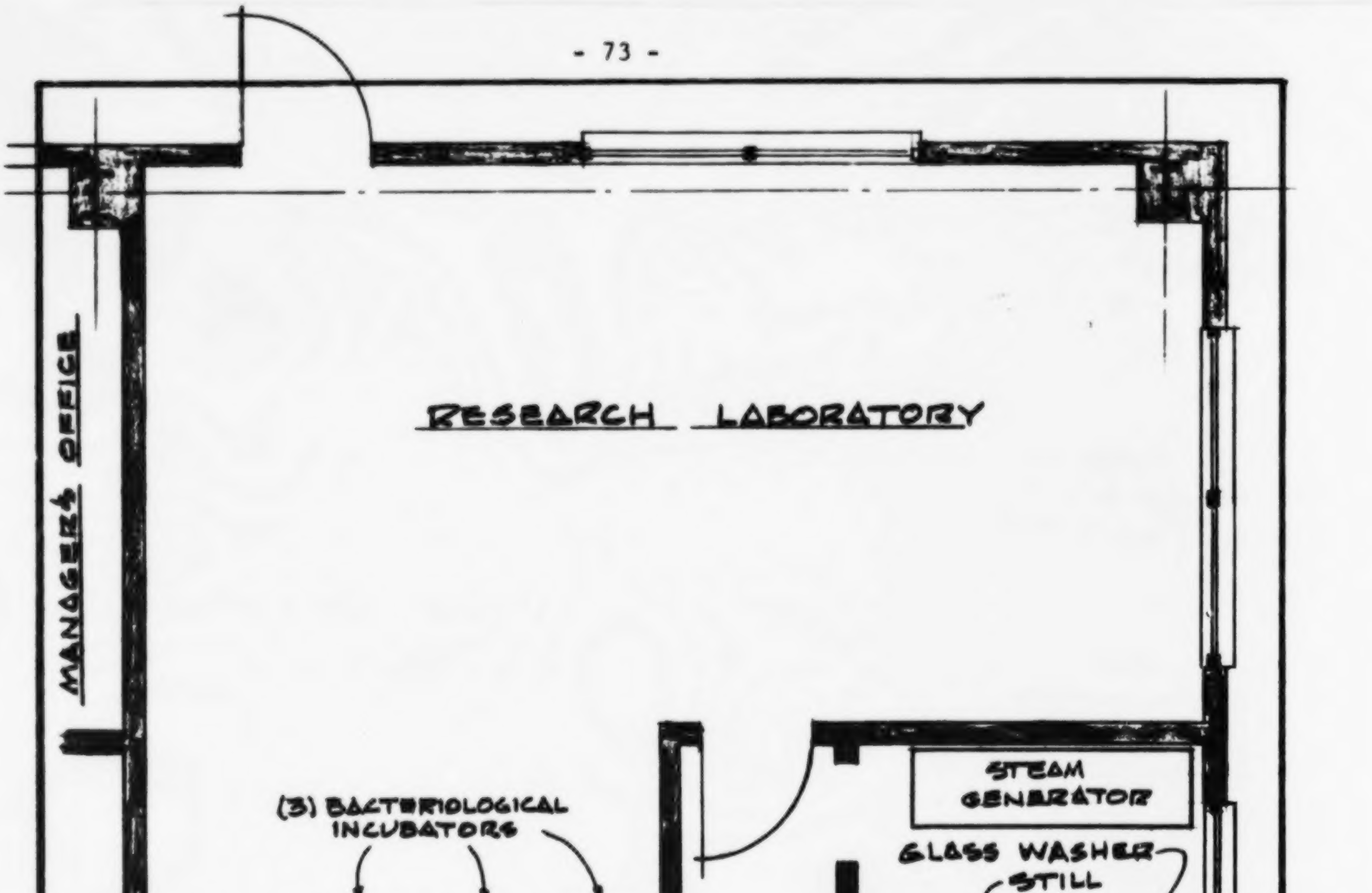

MANAGER'S OFFICE
GENERAL OFFICE
RESEARCH LABORATORY
(3) BACTERIOLOGICAL INCUBATORS
STEAM GENERATOR
GLASS WASHER
STILL
KJELDAHL APPARATUS
VENT
HOT PLATE IN FUME HOOD.
WATER BATH
INDUCTION FURNACE
WEIGHING TABLE W/ BALANCE
DRYING OVEN
Ph METER
MOISTURE BALANCE
NORTH

FIG 38

PLAN VIEW OF LABORATORY SHOWING PRINCIPAL PIECES OF EQUIPMENT

SCALE $\frac{1}{8}$" = 1'-0"

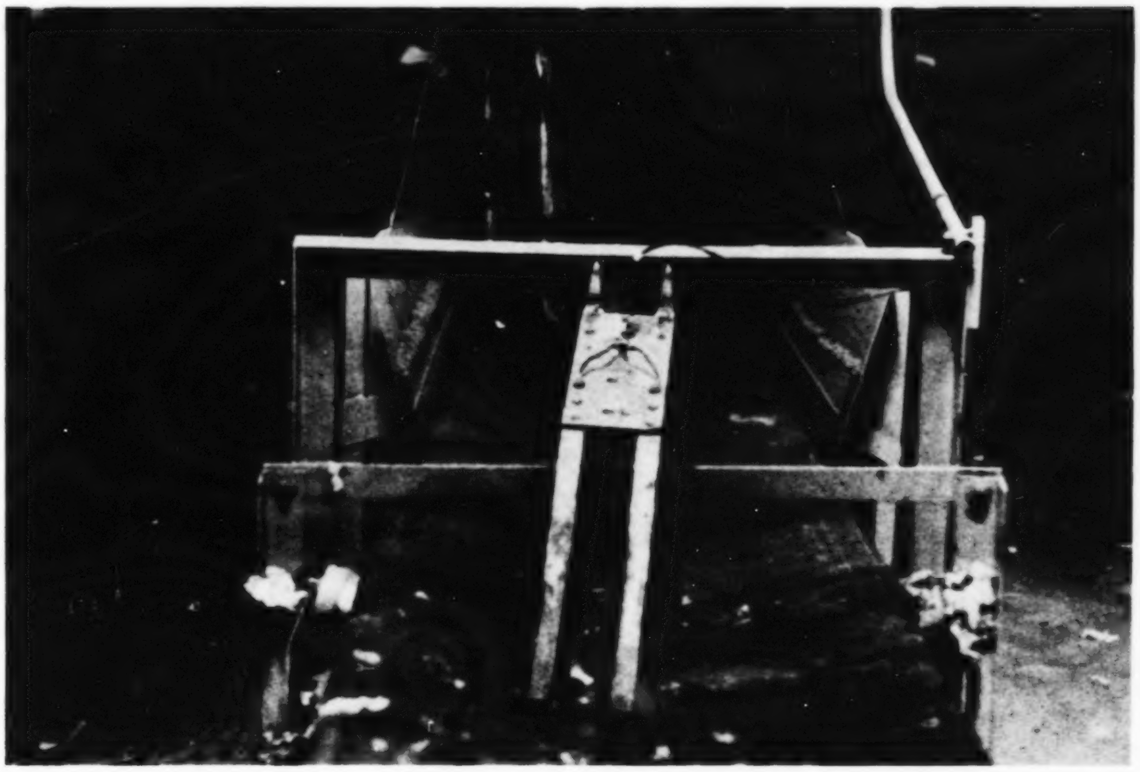


FIGURE 39 Moisture Sensing Electrodes

on the surface of the ground refuse as it is conveyed from the mixing screws following the secondary grinder to the digester tanks (See Figure 39). The electric signal from these electrodes activates a variable speed pump which supplies either water or sewage sludge to the refuse in the mixing screws in order to maintain a pre-selected moisture content in the ground refuse. A limit switch is connected in the circuit so that if no compost is on the conveyor belt (i.e., the electrodes pivot down to the surface of the conveyor belt) the pump will not operate.

The specific components of this system are listed in Appendix D.

4. Temperature Sensor Probes. As described in a previous section of this report, the composting process is a batch-type operation with each batch consisting of the refuse from one day's operation. This batch is placed in the digester tank where it remains for a six-day digestion

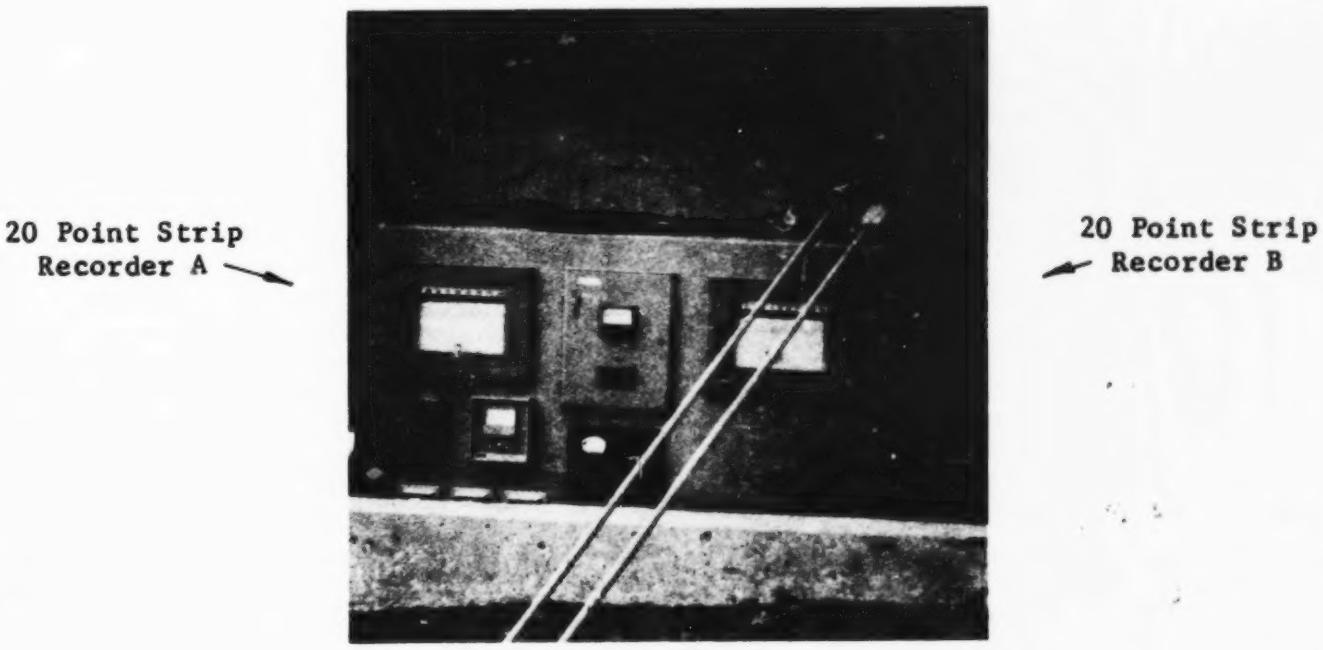
period. During the digestion period, except for the short period when the compost is agitated, the temperature of each batch is continuously monitored with a copper-constative thermo-couple sensing probe, 24 inches long, which is inserted horizontally into the pile through an opening in the digester wall. The probe is withdrawn when the batch is agitated and then reinserted immediately upon completion of this operation.

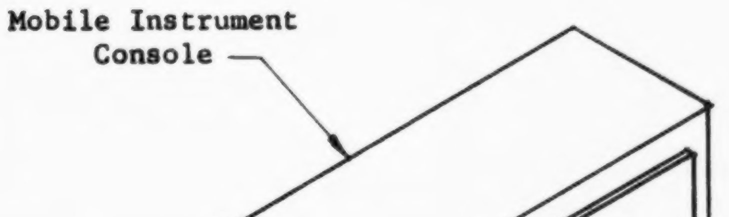
There are four such temperature probes in each digester located at the quarter points of the digester length. The temperatures recorded at the eight locations are recorded on an eight point strip chart recorder.

The specific components of this system are included in Appendix D.

5. Mobile Instrument Console. A new and unique instrument package has been developed for the Authority by Honeywell, Inc. This is a Mobile Instrument Console package, shown in Figure 40, Page 76, which can travel the length of the west digester tank and is equipped with one probe to measure temperature at five levels, and dew point, O_2, and CO_2 at four levels in the compost pile. A second probe measures temperature only at five levels. A third component of the package is a pressure-sensing unit which can be connected by means of snap-lock fittings to any of sixteen pitot tubes permanently placed in every other air duct which supplies air to the west digester tank. There is also a tap next to each pitot tube for sampling for dew point and the O_2 and CO_2 content of the air being supplied to the digester tanks.

The two probes are constructed of 3/4" diameter fiberglas tubing and have a pointed wooden plug in the bottom end. Both probes have


20 Point Strip Recorder A
20 Point Strip Recorder B


Mobile Instrument Console
1
2
3
4
5
6
7
8
9
Digester Sensing Probes

1. Compost Temperature Recorder A
2. O_2 Analyzer
3. Compost Data Recorder B
4. Suction Pump On-Off Switch with Indicator Light.
5. CO_2 Analyzer
6. Inlet Air Volume
7. Signal Transducer for converting signal from O_2 analyzer.
8. Signal Transducer for converting signal from dew probe and ambient temperature thermocouples.
9. Signal Transducer for converting signal from CO_2 analyzer.

FIGURE 40

Mobile Instrument Console

thermo - couples at 6", 24", 48", 72" and 90" from the tip of the probe and one has gas sampling ports 32", 48", 64", and 90" from the tip.

The instrumentation is arranged so that both probes can be used to measure temperature concurrently. The temperature from each of the ten points is recorded on a 20-point strip chart, Recorder A.

The other variables, i.e., inlet air volume, CO_2, O_2, dew point temperature, and also ambient temperature, are measured and recorded on a second 20-point strip chart recorder, Recorder B, which has a stepping switch to operate solenoid values to route the sampled gas stream to the appropriate analytical instrument. The analyzing and recording sequence is described in Figure 41, Page 78.

Figure 42, Page 79, shows a Schematic Flow Diagram of the Mobile Instrument Unit. The specific components of the Unit are listed in Appendix D. The cost of this instrument was $15,600 of which about $12,400 was for hardware and the remainder for developmental work and fabrication.

6. Evaluation. A program will be set up for Evaluation Control for major technical instrumentation and equipment. Initially, it is believed that an Evaluation Control Program similar to that planned for Mechanical Equipment (See Section V E, Page 64 and Figure 36, Page 66) will be adequate. This will be modified as found advisable.

B. Chemical Analyses. It was anticipated that chemical analyses would be performed according to the official A.O.A.C. procedures which are commonly used in the inorganic fertilizer industry. However, through subsequent conversations

OPERATING, ANALYZING AND RECORDING SEQUENCE

20-POINT STRIP CHART RECORDER B

Step	Activity
1	Activation
2	The ambient air temperature at the mobile instrument console as measured by a thermo-couple is recorded.
3	The gas flow rate in an air duct is measured by a pressure differential transmitter connected to a pitot tube in the air duct and recorded.
4	An air stream from the aeration duct is routed through a nondispersive in IR CO_2 analyzer and the CO_2 concentration recorded.
5	The air stream from 3 is routed through an O_2 analyzer and the O_2 concentration is recorded.
6	The air stream from 3 is routed past a dew probe and the dew point temperature is recorded.
7	Activation
8	The CO_2 concentration from the 32" level is measured and recorded.
9	The O_2 concentration from the 32" level is measured and recorded.
10	The CO_2 concentration from the 48" level is measured and recorded.
11	The O_2 concentration from the 48" level is measured and recorded.
12	The dew point temperature concentration from the 48" level is measured and recorded.
13	Activation
14	The CO_2 concentration from the 64" level is measured and recorded.
15	The O_2 concentration from the 64" level is measured and recorded.
16	The CO_2 concentration from the 90" level is measured and recorded.
17	The O_2 concentration from the 90" level is measured and recorded
18	The dew point temperature concentration from the 90" level is measured and recorded.
19	Blank
20	Blank

FIGURE 41 Operating Step Sequence, 20-Point Strip Chart Recorder B

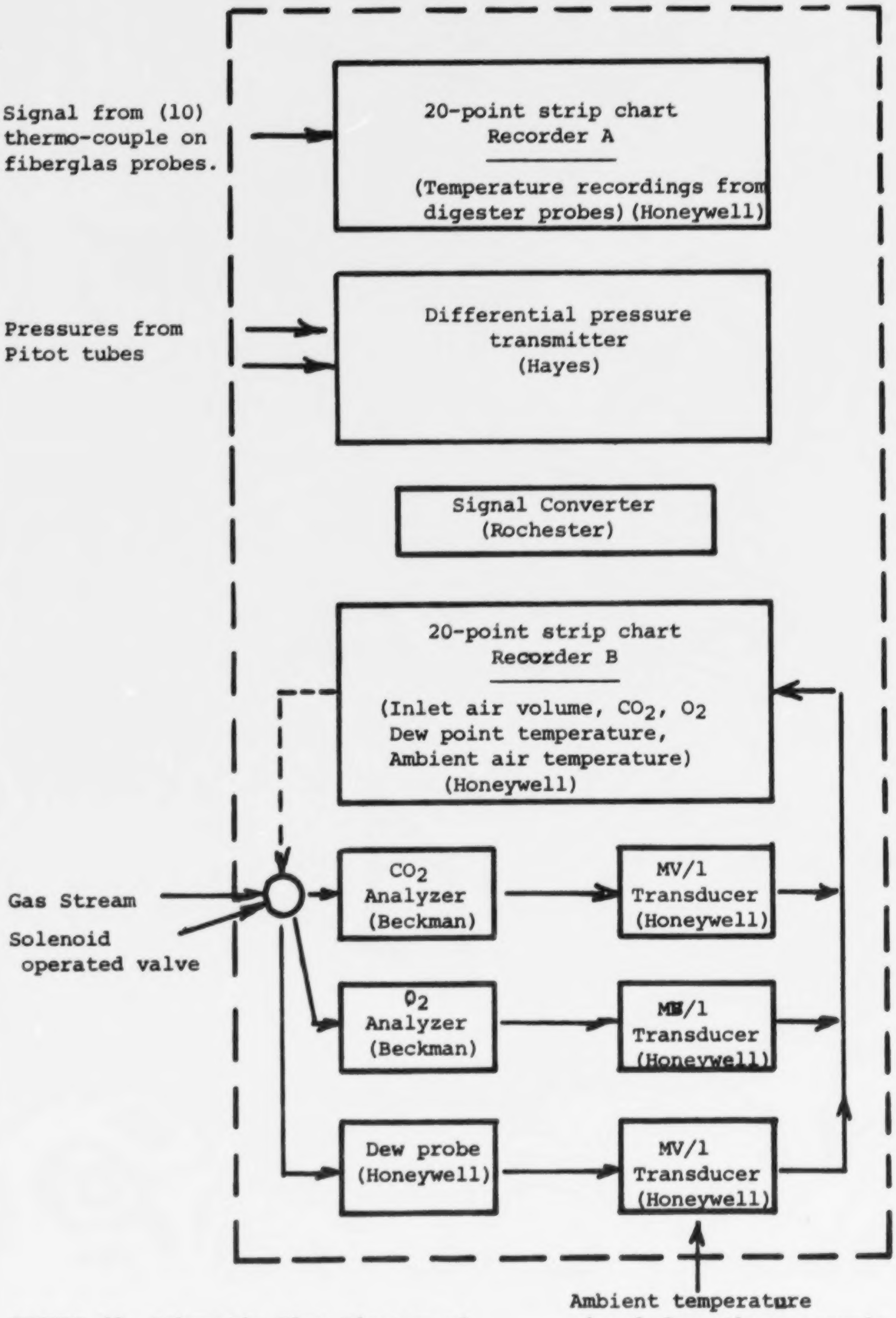

Signal from (10)
thermo-couple on
fiberglas probes.
20-point strip chart
Recorder A
(Temperature recordings from
digester probes) (Honeywell)
Pressures from
Pitot tubes
Differential pressure
transmitter
(Hayes)
Signal Converter
(Rochester)
20-point strip chart
Recorder B
(Inlet air volume, CO2, O2
Dew point temperature,
Ambient air temperature)
(Honeywell)
Gas Stream
Solenoid
operated valve
CO2
Analyzer
(Beckman)
MV/1
Transducer
(Honeywell)
O2
Analyzer
(Beckman)
MV/1
Transducer
(Honeywell)
Dew probe
(Honeywell)
MV/1
Transducer
(Honeywell)
Ambient temperature
signal from thermo-couple

FIGURE 42 Schematic Flow Diagram of Mobil Instrument Console

with the U.S. Public Health Service personnel and consultations with the technical staff of the U.S.P.H.S. demonstration compost plant at Johnson City, Tennessee, it has been agreed that the procedures suggested by A.P.W.A. are applicable and better suited in this case. Consequently these procedures as described in Municipal Refuse Disposal will be used in this program. At the present time, not enough work has been done to determine whether or not modifications will have to be made in these procedures.

1. Sampling Schedule. The tentative sampling schedule for routine analyses will involve collecting one composite sample per day from the raw ground refuse and one composite sample per day from the digested product as it is removed from the digester tank. A specific sampling procedure has not yet been selected.

2. Routine Analyses. Initially, the routine chemical analyses that will be run on each sample are:

a. Total Carbon
b. Total Nitrogen
c. Phosphorus
d. Potassium
e. Moisture
f. pH
g. Volatile Solids

Figure 43, pages 81 and 82 following, shows sampling frequency and procedures planned for chemical analyses, together with modifications planned in procedures to be used and reasons for modifications.

3. Periodic Analyses. Periodically the nitrogen determination on regular refuse and compost will be broken down into ammonical, nitrate, organic soluble, and organic insoluble nitrogen. The data gathered from these tests will then serve as a basis to evaluate the effects of nitrogen fortification which will be carried out later in the program. The BOD and perhaps the COD of the compost will be determined periodically as a measure of product stabilization. It is anticipated that particle size analysis will be conducted by sieving as part of the quality control program.

Sample Size	Number of Composite Subsamples	Sampling Frequency*	Determination **	Method of Analysis	Modifications
100 grams	Approximately 4	2 hour intervals	Carbon	APWA	1) Increase sample size from 50 mg. to 100 mg. 2) Add a small amount of Alundum to the platinum crucible before putting in samples 3) Use 1.0 N NaOH in place of 0.1N NaOH absorbing solution 4) Digest precipitate in water bath at 70°C instead of at room temp. 5) Use medium porosity glass frit filtering crucibles in place of Gooch crucibles. 6) Dry precipitate overnight at 75°C instead of 1 hour at 105°C.
"	"	"	Nitrogen	APWA	None
"	"	"	Potassium	APWA	1) Use either HNO_3-H_2SO_4 mixture or add a small amount of mercuric oxide to the digestion flask.
"	"	"	Phosphorus	APWA	1) Same as for potassium
"	"	"	pH	APWA	None
"	"	"	Moisture	APWA (oven dry)	None

* Anticipated

** All of these analyses are to be done daily on a composite of the ground, moistened raw refuse and on a composite of the compost product as finally ground before storage.

Figure 43 Chemical Analyses Sampling and Analysis Procedures

REASONS FOR MODIFICATIONS

Carbon:

1) Increase the amount of $BaCO_3$ which is finally weighed. Should reduce errors.
2) Prevents fusion to the bottom of the crucible of the glass chips in the compost.
3) To insure that the absorbing solution does not become saturated.
4) Results in a precipitate which settles faster and filters easier.
5) More convenient.
6) Oven must be kept at 75°C for drying compost samples.

Potassium

1) Sulfuric acid alone will not completely digest compost.

Phosphorus

1) Same as for potassium.

Figure 43 (Continued)

The results of the routine chemical analyses and any special analyses that might be deemed necessary to conduct, the bacteriological analyses, and measurements made with the mobile instrument package will be correlated as discussed in the section of this report entitled "Special Studies".

C. Biological Studies.

1. Investigation Study Program. The biological studies of the Gainesville Compost Plant during the last year of operation have involved three phases of investigation. These have had to do with:

   a. The bacteriological quality of the compost and related agricultural products for sale in Florida;

   b. An arthropod and rodent control program;

   c. An occupational health program for the employees of the plant.

Progress has been made in each aspect of the biological work. Preliminary accomplishments for the most part have been the establishment of methods and procedures important to this demonstration project.

2. Investigative Studies to Date. During 1967 samples of compost and other soil conditioners have been tested for the presence of coliform organisms. Membrane filtration of the samples proved unsuccessful. Due to the low numbers of coliforms found, dilutions free of organic debris were not able to pick up any coliform colonies. The MPN technique seems therefore to be the method of choice.

In carrying out the bacteriological program, it was interesting to note that in sampling various organic residues offered for sale in Florida for agricultural purposes that items such as cattle manure or digested sludge from sewage treatment plants contained coliforms at various levels and also contained at times significant numbers of fecal coliforms.

The following is a description of the composts and soil conditioners sampled:

Compost No. 1 - Received on 8/7/67, from PBL Products, St. Petersburg, Florida. It is not dried before packaging as it loses approximately 50% of its weight on drying. All weight determinations were made by drying material at 103°C. for 24 hours. Also, the compost contains no sewage sludge.

Compost No. 2 - Received on 8/17/67. This compost is Metroganic compost, from the Houston plant. This sample contains compost plus sewage solids. The weight loss on drying for this compost is 5.4%. The sample appears to have been previously dried.

Composted Cow Manure - This sample was obtained from Johnson & Ferris Feed Store at Gainesville, Florida, on 8/8/67. It is compost and cow manure in approximately equal parts. It is not dried and moisture loss is 43.2%. The brand name is Black Gold and it is put out by Colonial Feed & Fertilizer Company, Tampa, Florida.

Dried Cow Manure - This sample was also obtained from Johnson & Ferris on 8/8/67. It is "Wizard" brand heat treated, dried cow manure prepared by the St. Louis National Stockyards, National Stockyards, Illinois.

Milorganite - This sample was obtained from the grounds keeper at the University Faculty Club, University of Florida. This sample is dried sewage sludge from the Milwaukee sewage treatment plant. Weight loss is about 8.5%.

These data are presented in Figure 43, pages 85 - 87.

To this time no isolates of Salmonella have been made from either dried cattle manure or digested sludge samples. However, unconfirmed isolates have been obtained from fresh sludge from the University of Florida.

DATA FROM COLIFORM DETERMINATIONS IN COMPOST AND SOIL CONDITIONER SAMPLES
8/9/67 - 9/10/67

COMPOSTS

Compost No. 1

Sample No.	Dry Weight (gms)	Presumptive MPN/gm(D.W.)	Confirmed MPN/gm(D.W.)
1	0.1852	0	0
2	0.2260	0	0
3	0.1215	0	0
4	0.2566	8.6	0
5	0.1164	0	0
6	0.7159	0	0
7	0.4685	0	0
8	0.4765	0	0
9	0.7817	0	0
10	1.2025	0	0

Compost No. 2

Sample No.	Dry Weight (gms)	Presumptive MPN/gm(D.W.)	Confirmed MPN/gm(D.W.)
1	0.6415	3.1	0
2	1.2676	0	0
3	0.7866	2.5	0
4	0.3988	0	0
5	0.9304	2.1	0
6	0.3078	0	0
7	1.9954	0	0
8	1.1674	0	0
9	0.4115	4.8	0
10	0.7964	2.5	0

Figure 44: Coliform Determinations in Compost and Soil Conditioner Samples

SOIL CONDITIONERS

Dried Cow Manure

Sample No.	Dry Weight (gms)	Presumptive MPN/gm.(D.W.)	Confirmed MPN/gm.(D.W.)	Completed MPN/gm.(D.W.)
1	0.7642	42.9		
2	0.7212	63.3	6.8	6.8
3	0.8430	30.8	5.8	5.8
4	0.8226	39.8	8.5	8.5
5	0.8365	39.6	10.6	7.7
6	2.0946	30.8	5.5	3.7
7	1.3880	51.7	3.9	3.9

Composted Cow Manure

Sample No.	Dry Weight (gms)	Presumptive MPN/gm.(D.W.)	Confirmed MPN/gm.(D.W.)	Completed MPN/gm.(D.W.)
1	0.5082	580		
2	0.5864	1976		
3	0.2170	*	24.4	6.2
4	0.7616	*	16.3	10.9
5	0.5644	5488	31.4	20
6	0.2735	5331	20	20
7	0.5141	6021	34.5	34.5
8	0.7623	2860	23.7	23.7
9	0.6145	2446	72.1	31.2
10	0.6905	3105	20	20
11	1.3350	2587	31.2	27.1

* s/s tubes showed gas at highest dilutions run.

Figure 44 (Continued)

Milorganite

Sample No.	Dry Weight (gms)	Presumptive MPN/gm.(D.W.)
1	0.2012	0
2	0.5817	0
3	0.8629	0
4	0.7607	0
5	1.4345	0
6	2.1092	0

SUMMARY TABLE OF COLIFORM CONTENT OF COMPOST SAMPLES AND SOIL CONDITIONERS

		Geometric Mean MPN/gm.(D.W.)		
Source	No. Samples	Presumptive	Confirmed	Completed
Compost No. 1	10	1.24	0	0
Compost No. 2	10	1.69	0	0
Milorganite	6	0	0	0
Dried Cow Manure	7	41.5	9.1(2)	6.2(2)
Composted Cow Manure	11	2805(1)	13.9(1)	7.3(1)

(1) Based on 9 samples

(2) Based on 6 samples

Figure 44 (Continued)

Samples of refuse collected at stages through the plant at Houston (which can receive and assimilate activated sewage sludge) were screened for total and fecal coliforms as well as Salmonella. (Figures 45 and 46, Pages 89 and 90). Five isolates were obtained from compost samples in various stages of digestion sent here from the Houston Plant. Only in the sample of ground garbage without the water addition were Salmonella-like colonies obtained. These isolates were sent to Dr. John Boring (Head of Salmonella Detection Laboratory, Emory University, Atlanta, Georgia) for confirmation. Dr. Boring indicated that these colonies were Citrobacter, a group closely related to Salmonella, but not considered pathogenic. The method used for screening for Salmonella is outlined in Figure 47, Page 91 following.

3. Cooperative program with Johnson City Technical Group. Procedures for field and laboratory analysis are being coordinated with those used at Johnson City, Tennessee. Close coordination is anticipated between microbiologists working at Johnson City and the group at Gainesville.

4. Arthropod and Rodent Control Program. The arthropod and rodent control program is underway at the plant and as far as can be determined has been successful in reducing the number of cockroaches and rodents entering the building. Because of the cold weather and the season of the year, no adult fly control has been initiated. This portion of the control program will begin in March or early April. A summary of these results to date is as follows:

TABLE OF DISTRIBUTION OF COLIFORMS IN COMPOST DURING DIGESTION AT HOUSTON COMPOST PLANT

Source of Sample	Presumptive MPN/gm	Confirmed MPN/gm	Fecal Coliforms MPN/gm	Dry Wt. (gm)	% Moisture	Digester Temp. °F
Ground Garbage Without Water	1609	13	4.6	1.3	28	-
	1609	13	-	1.0		
	1609	19	-	0.9		
Ground Garbage with Water	88 x 100	88 x 100	None in	0.8	59	-
	195 x 100	195 x 100	Dilutions	0.9		
	240 x 100	240 x 100	Tested	0.7		
One Day Composting	1609	60	0	0.8	55	122
	1609	58	-	1.2		
	1609	0	-	0.9		
Two Day Composting	1609	0	0	1.2	50	130
	1609	0	-	1.4		
	1609	0	-	0.9		
Three Day Composting	1609	0	0	1.2	50	154
	1609	0	-	1.4		
	1609	0	-	0.9		
Four Day Composting	No Gas	-	-	1.5	45	168
				1.6		
				1.0		
Five Day Composting	No Gas	-	-	1.0	45	170
				0.9		
				1.3		
After Complete Digestion	No Gas	-	-	1.0	45	170
		-	-	1.2		
				1.3		
After Final Grinding	No Gas	-	-	1.4	48	-
				0.9		
				1.1		
Thirty Day Old Compost With Water	No Gas	-	-	1.2	46	-
				2.0		
				1.8		

Figure 45 TABLE A DISTRIBUTION OF COLIFORMS IN COMPOST

TABLE OF SALMONELLA PRESUMPTIVES IN GROUND REFUSE AT HOUSTON COMPOST PLANT

Sample Number	TSI (Butt Slant)	Phenylalanine	Citrate	Urea
1	Acid Alkaline	-	+	No Splitting
2	Acid Alkaline	-	+	No Splitting
3	Acid Alkaline	-	+	No Splitting
4	Acid Alkaline	-	+	No Splitting
5	Acid Alkaline	-	+	No Splitting

Figure 46 TABLE OF SALMONELLA PRESUMPTIVES IN GROUND REFUSE

Figure 47 Flow Sheet for Salmonella Screening

Each 5 gram Subsample

Plant into ≃ 25 ml. tetrathionate broth

Incubate 48 hours at 37°C

Streak two plates of brilliant green agar

Incubate 24 hours at 37°C.

Pink or colorless colonies -
pick to TSI slants
(stab and streak)

Incubate 24 hours at 37°C

Green colonies -
discard as lactose fermenters

Butt acid yellow
Slant alkaline (red)
and/or H_2S + blackening) -

Inoculate
1. Urea agar
2. Phenylalanine agar
3. Simmons citrate agar

Incubate 24 hours at 37°C

Butt and slant acid (yellow)-
Discard as lactose fermenter

Urea - (no red color)
Citrate + blue
Phenylalanine - no green color with test reagent
Possible Salmonella,
re-inoculate TSI slant

Incubate 8-24 hours at 37°C
Proceed with testing for Somatic, "O" antigens with polyvalent "O" antiserum

Urea + (red)
Citrate + (blue)
Phenylalanine
(blue to green pigment and grape like odor)
discard as Pseudomonas Eruginosa

Urea ±
Citrate ±
Phenylalanine + (green with test reagent) -
discard as Providence

Urea + (red)
Citrate + (blue)
Phenylalanine ±
discard as Proteus

Poly "O" positive
(good agglutination)
Test with "O" groups A→1

Poly "O" negative
(no agglutination)
discard as non Salmonella

Any group positive
(good agglutination)
Probable Salmonella
send culture to CPC
in Atlanta, Ga. for
confirmation

All groups negative-
Test for washing "Vi"
antiserum

"Vi" positive
Boil for 10 minutes to destroy "Vi" antigen then test again for "O" groups A-1

Vi negative
Discard after repeating biochemical and serological tests as non-Salmonella

---

any "O" group positive -
Probable Salmonella -
send culture to CDC in
Atlanta, Ga. for confirmation.

Negative -
discard as non-Salmonella
after re-testing biochemical
and serologic properties

Figure 47 Flow Sheet for Salmonella Screening

a. Rodents - Numerous bait stations have been placed in strategic areas throughout the building. The pesticide of choice is a dry Pival bait which is prepared as indicated in Figure 48, Page 93. This bait is placed in 4 x 4 cardboard trays around the outside walls and at about 50 ft. intervals. Four to six of these trays should be placed in the unloading area. Experience has shown that bait trays need to be protected from dust generated by the composting operation.

If water is not plentiful in the immediate area, liquid Pival bait stations may also be used. Pival should be mixed at a rate of 1 lb./10 gallons of water. If ample water is available for rodents, baiting with liquid Pival will be useless since the rats will not drink from this type of bait station.

Bait stations are checked twice a week and fresh bait is distributed twice a month. Frequency of visits to bait stations and observations of live or dead rats are used as indicators to determine the necessity of increasing the number of bait stations and the frequency of fresh bait distribution.

b. Roaches - One quart Mason jar roach traps (R.H. Maltby, unpublished thesis, University of Florida, December, 1967) baited with stale beer have been distributed recently throughout the building. These traps have not yielded any roaches to date. A modification of these jar traps will be made so as to be more effective in trapping roaches. Traps are visited daily and roaches are preserved for species identification. Identification of specimens will be made weekly.

Diazinon AG500 (Geigy) is used for control of roaches inside the compost facility and adjacent buildings. Liquid toxicant is prepared by adding 4 lbs. Diazinon per gallon of solvent. This concentration is added at the rate of 2.5 oz./gal. of water for spraying. This mixture is applied with a pressure sprayer (hand operated) to all possible hiding places as well as in a 12 inch band at the base of all inside walls.

A light sprinkling of granular Heptachlor or chlorodane is applied around the entire outside wall. This aids in preventing the migration of cockroaches and ants into the building from the surrounding wooded area.

1. Rat and mouse dry bait

8 lbs.	corn meal
1/2 lb.	confectioners sugar
1 lb.	Pival
3 lbs.	rolled oats

2. Liquid bait

1 pack prepared Pival
2 tablespoons sugar
1 qt. water

3. Roach spray

2 1/2 oz.	Diazinon
1 gal.	Water

Figure 48 Rodent and Roach Bait and Spray

c. Flies. Modified conical fly traps, on loan from the United States Department of Agriculture Insects Affecting Man and Animals Laboratory, Gainesville, Florida, are available for use. These traps will be placed in strategic locations during the fly season. Fly traps are not operated at this time in order to avoid interference with the final construction of equipment.

The traps are designed to capture several species of flies according to the bait that is used. When trapping operations begin, several baits will be used in an attempt to obtain a representative sample of species. Insects nets will also be employed to make sweeps throughout the area in an effort to supplement the trap samples.

Arrangements have been made for the procurement of marked flies from the U.S.D.A. Laboratory. These flies will be used in conjunction with grid count data to compute a population estimate. These operations will begin after trapping operations are started.

5. Occupational Health Program - Dr. George Little, Gainesville, Florida, has given physical examinations to workers in the compost facility. On his recommendation, all workers will be interviewed at six-month intervals following the initial physical examination to determine on an informal basis any changes which may have occurred in their health status. Specific tests included in the physical examinations were hematocrit, hemoglobin and urinalysis. Subsequent to a conference with U.S. Public Health Service personnel at the Johnson City, Tennessee, compost plant, Mantoux and Histoplasmin skin tests will also be included for all workers.

To year end, sixteen complete physical examinations have been given. Four employees have not been examined because of failure to keep scheduled appointments. All of the employees are males ranging from 18 to 51 years of age with an average age of 31 years. There is no evidence of any physical abnormalities except in two employees, who have a conductive hearing loss.

Fairly complete blood examinations have been made including hematocrit (cell mass/blood volume) and hemoglobin. VDRL tests were also run on all workers. The results of the blood examinations were normal and no positive VDRL's were obtained.

Urine samples were examined for pH, specific gravity, glucose, acetone, occult blood and protein. The results of all these tests were normal. All employees were given containers to collect and submit stool samples for examination. As of December 31, 1967, five of sixteen had completed this phase of the medical examination. These stool samples are checked for hookworm, Ascaris and tapeworms. All submitted have been negative, however, one patient has a ciardia infection.

There have been four accidents which have required the attention of a physician. All of these were minor falls or bruises sustained from an object dropped on a worker's foot.

Chest x-rays have yet to be completed on employees. This examination will be done with the cooperation of the County Health Department. It is anticipated that noise level tests will also be conducted at the several locations within the compost plant.

6. Testing Procedures Planned. Microbiological studies at the compost facility will include the detection of total coliform, fecal coliforms and Salmonella in each daily composite sample brought into the plant. Samples will be withdrawn and composites will be made of raw ground refuse as well as finished compost.

The sampling protocol will be such that daily composites will be taken from primary ground waste and finished compost coming out of the digester tank. Figures 49 and 50, Pages 97 and 98 following, show a breakdown of the sampling frequency, tests, etc. and give flow-sheets for the coliform and salmonella determinations. The sampling frequency was established by the Florida Board of Health which is interested in obtaining sufficient baseline information of the bacteriological content of compost to permit a judgment as to its sanitary quality.

Presently, it is not planned to assess the presence or numbers of pathological fungi, helminths, parasitic protozoa, or viruses at the Gainesville plant. Instead, at least initially, it is hoped that a certain number of samples from the Gainesville project will be submitted to the United States Public Health Service demonstration compost plant in Johnson City, Tennessee, for the detection of these particular organisms.

D. Special Studies. In addition to the routine chemical analysis and bacteriolgical tests listed in this report, other studies will be conducted and bacteriological factors that affect and result from composting and the inter-relationship between these factors. These studies have not been designed but a description of the type of work anticipated will be given.

1. Compost Stabilization Parameter. Other studies will involve the selection of some parameter (such as BOD) to measure the stability of compost and subsequent studies using this parameter to evaluate the rate of stabilization as a function of digestion time, aeration rate, O_2 content of aeration air, and moisture content of the ground refuse. A study will also be made to evaluate the effect of the C:N ratio on digestion time and rate of stabilization.

Test	Sampling Points	Sampling Frequency	Size of Sample (wet wt.)	Size of Sub-Sample (wet wt.)	Number of Sub-Samples	Differential Media used
Total Coliforms	After primary grinding and after final grinding	One Composite per day from each point	50-60 grams	5 grams	3	Brilliant lactose broth
Fecal	"	"	"	"	"	E. C. medium
Salmonella	"	"	"	"	5	Phenylalanine agar Simmons Citrate Urea Agar, and "O" group serology

Figure 49 Microbiological Sampling and Testing Schedule

Figure 50 Flow Sheet for Coliform Determination

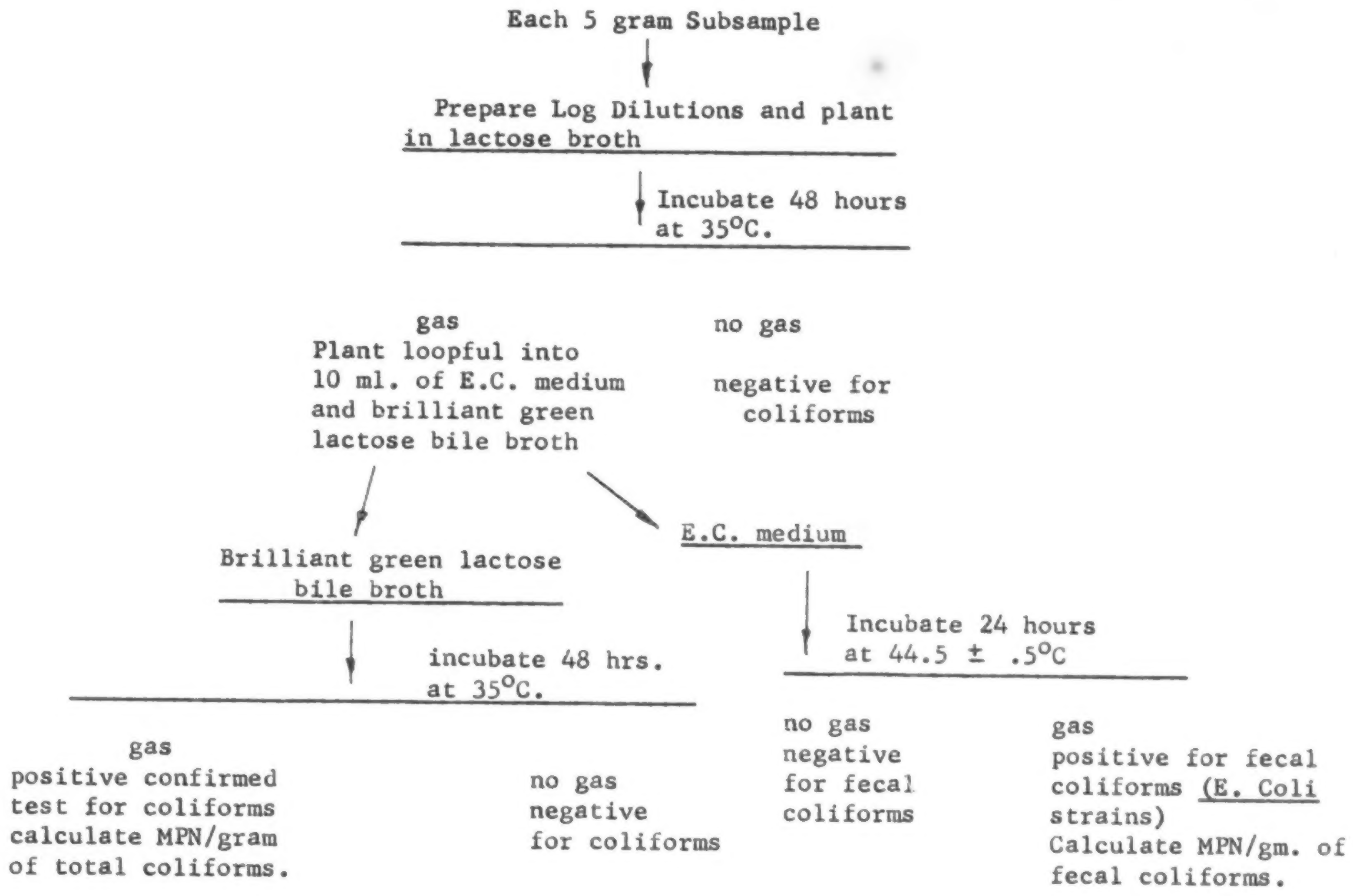

Each 5 gram Subsample
Prepare Log Dilutions and plant in lactose broth
Incubate 48 hours at 35°C.
gas
Plant loopful into 10 ml. of E.C. medium and brilliant green lactose bile broth
no gas
negative for coliforms
Brilliant green lactose bile broth
E.C. medium
incubate 48 hrs. at 35°C.
Incubate 24 hours at 44.5 ± .5°C
gas
positive confirmed test for coliforms calculate MPN/gram of total coliforms.
no gas
negative for coliforms
no gas
negative for fecal coliforms
gas
positive for fecal coliforms (E. Coli strains)
Calculate MPN/gm. of fecal coliforms.

Figure 50 Flow Sheet for Coliform Determination

With the mobile instrument console, it will be possible to follow the variability of several parameters in the digester tank. Such studies might include the relationships between the aeration schedule (rate and volume) and moisture content, between aeration and pile temperature, between aeration and the O_2 profile, and between aeration and the CO_2 profile. The rate of O_2 depletion and CO_2 production at various levels in the pile can also be followed.

2. Study Effects of Enrichment. It is also proposed to enrich the ground refuse with various forms of nitrogen and determine these effects on the rate of digestion, digestion temperature, bacterial populations, and forms of nitrogen in the digested product.

3. Sewage Sludge Studies. As soon as approval has been granted by the Florida State Board of Health, sewage sludge, both digested and raw, will be added to the ground refuse and the effects of this will be studied at several levels.

The Gainesville project offers a very favorable opportunity for studying and testing the techniques, procedures, results, benefits, and necessary safeguards in the utilization of sewage sludge by appropriate mixing with processed refuse solids and digesting under carefully controlled conditions by thermophyllic aerobic microbial action. The Sewage Treatment Plant of the City (on the site of which the Compost Plant is located) receives the sewage of the entire city, about 5 million gallons per day.

The City has agreed to install a sludge line to the Compost Plant as soon as a current construction program has been completed, and also to install the necessary piping and valves so that either raw or digested sludge can be pumped to the Compost Plant. Prior to making commercially available compost which contains sewage sludge, pathogen survival will be assessed for selected organisms under controlled conditions. These tests will determine pathogen survival as a function of temperature, oxygenation, agitation, time and other critical factors, which can be controlled in the composting system installed at the Gainesville Plant.

Separate Pathogen Survival Research Grant, to be directed by Dr. George Davis, has been applied for and is now pending before the National Center of Urban and Industrial Health (see Paragraph VIII-F, Page 103). The funding of this grant will substantially increase the utilization of the project facilities to study the important matter of pathogen survival.

Another feature expected to be of substantial benefit in this regard is the close cooperation of the technical staff at the U.S.P.H.S. Compost Plant at Johnson City, Tennessee, which has the capability of extensive laboratory research in the sewage field, and the cooperation of the staff of both the Department of Environmental Engineering and the School of Medicine of the University of Florida, both of which are interested in the Project and willing to participate in this phase of the program.

In the utilization of sludge, when the necessary tests have been conducted and safety parameters have been established, it is expected that the City will pump sludge at about 4% solids, to the Compost Plant. The sludge will be stored in the larger concrete storage tank, will be kept aerobic (and in some circulation) by injection of air, and will be pumped to the sludge mixing screws (Figure 18, Page 33) by the Variable Speed Moyno Pump (Figures 17 and 20, Pages 33 and 35). The pump speed is controlled by the Honeywell Moisture Sensor (Figure 39, Page 74). Under the Metro-Waste System, enough moisture is added to the processed refuse to be digested to give a final moisture content of 60% to 65%. While full operations have not yet been conducted, it is expected that all or nearly all of the sludge solids generated at the City Sewage Plant can be digested with and so disposed of with the solid wastes to be processed at the plant.

4. Other Special Studies. In addition to the studies of a chemical and process nature, various microbiological studies will be conducted to determine the suitability of compost for use where eventual human contact will result. The microbiological phase of the entire program will be expanded greatly if a grant for work proposed by Dr. George Davis of the University of Florida is funded. As the plant operation becomes routine, it will become more clear what specific studies should be conducted and what schedules should be adapted.

VIII UNIVERSITY RELATED PROJECTS

A very important facet of the entire project is the close working relationship with the University of Florida, including the School of Engineering, the Agricultural Experiment Station of the University, and the School of Medicine, which was established at the inception of the Project and has continued throughout. In addition to close association during the planning and initiation of the Project, the relationship between the University and the Authority has been developed in the following additional ways:

A. Solid Waste Training Program Grant. One of the objectives of the compost demonstration grant was to develop a further interest in solid waste disposal at the University of Florida. The results thus far have included the establishment of a solid waste training program grant, grant number UI-01012-02, from the National Center for Urban and Industrial Health, United States Public Health Service. The grant is presently under the directorship of Professor Thomas deS. Furman of the Environmental Engineering Department, University of Florida. Presently two courses are included in the curriculum; one entitled "Municipal Refuse Practices" (dealing with the collection of refuse), and the other entitled "Solid Waste Disposal" (dealing with various methods of disposing of solid wastes). A project of the latter course was the preparation by each student of a composting feasibility study for Duval County (Jacksonville), Florida, and a similar study on the feasibility of landfill for High Springs, Florida.

B. Mycology Study Grant. A related mycological study is being done under the auspices of the solid waste training grant number UI-01012-02. Some studies have indicated that the thermophillic fungi are important or necessary to establish thermogenesis in compost. There is also evidence to indicate that they may play a role in reduction of pathogen survival times. Further work is needed to be made to determine the potential pathogenicity of these fungi themselves.

This investigation consists of sampling various stages of the thermogenesis of compost processed by the Metro-Waste System in the Demonstration Plant in Gainesville to determine the population succession of fungi. The initial investigation is being limited to fungi that grow at 45°C or higher. Insofar as possible, identifications and sub-cultures are being made of the isolates. Some preliminary work on the nutrition and physiology of these organisms is being attempted. At the present time, of the trial samples that have been collected, four isolates have been successfully subcultured at 50°C. Further tests of their temperature range are being performed.

C. Analysis Study of Digester Tanks. The University of Florida teaching grant also supported a special student for one quarter. The project prepared by him was a cost optimization study of the number, size and shape of digester tanks, such as used in the Metro-Waste System, for compost plants with capacities varying from 50 to 1,000 tons of refuse per day. This study was in part computerized.

D. Analysis of Compost Usage on Soil Structure and Crop Production. A study conducted by Dr. C. C. Hortenstine of the Department of Agriculture, University of Florida, under NIH Grant Number UI-00521-02, is in process to determine the effects of garbage compost on soil and crop production. Two progress reports have been prepared under this grant but the results have not yet been released.

E. Integration with Teaching Programs. A program has been developed for students in the School of Engineering to participate on a part-time basis in the technical and scientific aspects of compost plant operations, and the students will also participate in the research programs expected to be conducted in connection with the plant.

F. Pathogen Survival Research Grant. The facilities and instrumentation presently available at the Project offer a unique capability for a particularly intensive research study into microbiological aspects of the composting process and operation of a municipal solid waste disposal facility of this type. An application for grant to finance such a study, to be directed by Dr. George Davis of the University of Florida is now pending with the National Center of Urban and Industrial Health.

G. Laboratory and Class-Conference Room. To facilitate the usage of the plant facilities by the University for the purposes outlined above, an attractive, accessible, multi-purpose room has been provided which will be available to the

University in connection with classroom, lecture and study purposes related to composting and the Project (Figure 4, Page 13, Office Floor Plan). Also, a large section of the laboratory space in the office building has been set aside for utilization by the University as a combination University Laboratory and Classroom (Figure 38, Page 72). It is expected that extensive use will be made of these facilities by the University, substantially enhancing the demonstration, evaluation, teaching and research potential of the Project.

H. Future Special Courses. With the emergence of the solid waste disposal situation in the United States as one of major national concern, it is believed that there will also come the awareness of a need for technicians particularly trained in laboratory techniques and the various operational and control requirements for efficient, nuisance-free operation of solid waste disposal facilities of this type, meeting adequate standards of Public Health and good sanitation. As these criteria develop, it is felt that, in all probability, there will be a useful place for the training of laboratory technicians, plant operating and control technicians, etc., and attention will be given to suitable training courses in these fields, to be planned and conducted by the University staff, utilizing the facilities provided by the Project.

IX RELATIONSHIPS WITH PUBLIC HEALTH AUTHORITIES.

The Project has been fortunate to have had the active interest, participation and support of Public Health Authorities at all echelons. This can be noted, as follows:

A. Alachua County Health Department. This Department has been alert to the solid waste disposal problems of Alachua County since 1964 when a detailed environmental health survey for the county was conducted by the Department, in cooperation with the Florida State Board of Health, the University of Florida, and with the assistance of a grant from the U.S. Public Health Service. Since the early consideration of the Project, officials of the County, including the Health Department, have been encouraging, cooperative and helpful in getting the Project formulated and under way. The Director of the Environmental Health Division of the Department has accepted appointment as a Trustee of the Authority, at the request of the other trustees representing the City, the County and the University, so the active interest and participation which has been shown by the County Health Department is now continuing to the maximum extent possible.

B. Florida State Board of Health. State health officials have, of course, played a key role in the entire Project. These officials were consulted prior to the filing of the initial grant application, and contributed in shaping the initial framework for the construction of the Authority, and formulation of the Project. Since the approval of the grant, continuous liaison has been maintained between the technical consultants of the Authority and the State Department of Health, important phases of the technical phase of the Project, including construction, equipment, and operational procedures, have been settled upon with the advice, consultation and approval of the State Health Department. Specific activities of the State Board of Health have included the following:

1. Approval of Plans. Prior to commencement of construction of the plant, detailed construction plans were submitted to the State Board of Health, revisions of same were made as requested, and approval of amended plans was received.

2. Inspection. Periodically during construction, representatives of the Board visited the site to inspect the project, review details of construction, and consult with the Project Director.

3. Conditions imposed by State Board of Health. With relation to the project, the Board has stipulated certain conditions to be complied with by the project, including the following:

a. Use of Sludge. As mentioned earlier (Par. IV-F-3, Page 36), the City of Gainesville has agreed to construct a sludge line from its nearby sewage treatment plant direct to the sludge holding tank on the project site. The sludge line is to be connected at the sewage treatment plant so that it can pump either digested sludge or raw sludge to the compost plant. Approval has been received only for the use of digested sludge for routine operating procedures. However, upon prior notice to the Health Authorities and the University, it is planned that raw sludge will be used, for test and experimental purposes, the compost produced using raw sludge to be delivered only to the University for research and experimental purposes pertaining to pathogen content and survival, pending further approval by the State Board of Health.

b. Air Pollution. The Board has specified that the emissions from the scrubber connected to the paper and plastics burner shall comply with the regulations of Chapter 170 C-9, Florida Administrative Code. These regulations specify that the particulate emission shall not exceed 0.2 grains per standard cubic foot of stack gas (corrected to 50% excess air). Standard conditions are defined as dry gas at 68^{o}F. and 1 atmosphere pressure.

c. Use of Compost. The sale and application of compost generated at the plant is regulated by the provisions of Chapter 170 C-10, Florida Administrative Code, which Act is administered by the Florida

State Board of Health. This Act requires that a plant producing compost be approved by the Board, and that periodic tests and analyses be made of the compost product generated at the plant, to insure that no pathogens or other materials may be present in the product to an extent which could be considered injurious to the health of users. Procedures to comply with this chapter of the Code are now being worked out in conjunction with the State Board of Health. Copy of Chapter 170 C-10 of the Florida Code, Section 10.09, is attached hereto as Appendix E.

C. U.S. Public Health Service. The Public Health Service has, of course, played the key and indispensable role for the entire Project. Subsequent to the passage of the Solid Waste Disposal Act of 1965, and prior to the issuance of regulations and grant application procedures in the early spring of 1966, officers of the Service were helpful in indicating guidelines that were expected to be set out when these procedures and instructions would be issued, and cooperated in the important planning and organizational activities that were required to precede the organization of the Authority and the Preparation of an application for a project grant of the magnitude and far reaching significance of this Project. With the expansion of the Solid Wastes Program, a number of changes of Public Health Service personnel assigned to this Project have taken place during this period, but with each such change, the new personnel became intimately familiar with the history and background of the Project, considerable effort was expended on their part to visit the Project site, become acquainted with the personnel involved and problems encountered to date. In a project of this size and significance, involving totally new concepts, principles and techniques in solid waste disposal, with not one plant of this type built or in operation when the project application was prepared, it was inevitable that many unanticipated problem situations should develop, with new ground to be plowed to achieve a successful solution. The particular appreciation of the project officers and trustees is expressed to the many personnel of the Health Service who have assisted and cooperated in bringing the Project to its present state of completion and preparation for an operating phase which it is believed will fully achieve the goals and objectives laid out at the inception of the Project.

X SUMMARY AND CONCLUSIONS

The foregoing Interim Report has attempted to lay out in reasonable detail the purposes underlying the formation of the Authority, the establishment of the Project, the historical background of the Project, the factors which were determinative in shaping the corporate structure of the Authority and the design of the solid waste disposal facility, the proper construction of which and the successful operation of which are, of course, the funadmental underlying objectives of the entire Project.

A. Construction Phase. The entire project period until the end of 1967, the period covered by this report, was devoted to determining the needs of the three municipal bodies to be served by the plant, study of the special features of site, volume, physical characteristics and other critical factors affecting design considerations, developing the design criteria necessary to effectively meet the foregoing factors, and then to design and construct a plant in accordance with these design criteria. This phase of the Project has been substantially accomplished with the close of the year 1967, the second official year of the Project.

B. Observations during Construction. Construction of the plant has proceeded generally as anticipated, except for three items which resulted in some delay of the Project.

1. Weather. Unfortunately, construction of the Project got under way during a spring of exceptionally heavy rainfall. Rather large excavations were required for the receiving ramp, retaining walls, digester walls and machinery foundations. Time and again, these excavations were washed out after having been dug, but before forms could be firmly placed. One additional moisture problem was encountered in the form of a spring discovered on the site of the main plant building. However, it proved possible to dig back far enough to divert the spring along the outside of the building and the foundations could be placed so as to cut off this flow.

2. Labor Relations. Generally, harmonious and effective labor relations were maintained during the construction phase of the Project. One unauthorized picketing situation occurred, based on jurisdictional matters, which caused union workers to stay off the job until they learned that the picketing was not authorized. They then returned to work and the matter was satisfactorily adjusted. However, about two weeks working time was lost to the Project.

3. Design Changes. As noted above, it proved possible, prior to final freezing of the design of the plant, to take advantage of the operating experience being developed at the Metro-Waste plant in Houston. With this plant going into actual operation, much important experience and information was developed relative to the handling of refuse materials on a large scale, and the efficiency and performance of particular items of machinery and equipment. For this project to best achieve its aims and objectives, it was felt to be important and worth while, despite the delays and additional cost involved, to modify the first design criteria and plans adopted for the project, so as to take advantage of the latest and most accurate information

and data available. The specific design changes made are listed in Paragraph C following.

C. Specific Design Changes made during the Year. As previously noted, after the Gainesville plant had been designed and just about the time construction was starting, the Metro-Waste plant of Lone Star Organics, Inc. went on stream at Houston, Texas. A number of items of important operating information were developed at this plant in Houston, and this project was given the benefit of this actual operating experience, with appropriate changes in plant design. The principal items involved in these changes include the following:

1. Receiving Ramp. Construction of receiving ramp of concrete, rather than asphalt.

2. Receiving Hopper. Enlargement of capacity of Receiving Hopper.

3. Receiving Area. Increase in capacity of receiving area and extension of receiving building.

4. Primary Grinder. Modification of plant to accept a Centriblast Disintegrator instead of the standard hammermill grinder.

5. Digesters. Increase of capacity of digesters.

6. Storage Area. Provision of storage area to hold compost for "curing" or "maturing" to achieve better degradation of fibrous material.

7. Bulk Storage Building. Addition of bulk storage building to provide protection for finished compost on site, for distribution to local bulk users.

8. Dryer. Utilization of dryer eliminated, because of need of moisture retention during curing period.

9. Scrubber. Scrubber added to burner system to meet new provisions of Florida Sanitary Code pertaining to particulate matter in stack emissions.

10. Salvage Metal Mill. A new item of equipment was added to the metal salvage line to put the shredded metal into a condensed pellet form, to increase the density for transportation purposes and for greater ease of handling.

D. Conclusion. It is felt that in this project a new trail is being blazed in the field of solid waste disposal. Because of the infant stage of this concept at the inception of the project, new problems had to be overcome, new solutions worked out, new techniques developed, and new plans and designs worked out. This has been particularly true in some of the technical, instrumentation and operational phases of the project. By taking advantage promptly of the experience gained at Houston, it is felt that in reality, over the long run, much time and money will have been saved, the plant will have much greater efficiency and service, the facility will have much improved technical control features, and the project will have much greater value as the most modern demonstration and research facility possible to build. Meanwhile, the patience, encouragement, cooperation and support of the Public Trustees, the three Public Participant bodies involved, the County and State Health Officials, and particularly the officials of the U.S. Public Health Service involved in the project to date, is much appreciated. It is sincerely believed that the information to be developed by this project and this demonstration of a new concept in solid waste disposal, based on constructive, conservation-oriented re-cycle principles, will be worth all of the time, effort, energy and investment made to date.

TABLE OF APPENDICES

Appendix	Item	Page
A	Machine and Equipment Specification Table	112
B	Personnel Chart, Plant Personnel	117
C	Table of Major Laboratory Equipment	118
D	Table of Process Instrumentation Systems Components	119
E	Chapter 170 C-10, Florida Administrative Code, Sec. 10.09	120

MACHINERY AND EQUIPMENT SPECIFICATION TABLE
GAINESVILLE MUNICIPAL WASTE CONVERSION AUTHORITY, INC.

Description and Size	Manufacturer or Supplier & Model No.	H.P.	RPM of Screw, driver or head pulley	Dia. in inches of head pulley or screw	Belt Speed in feet per minute	Capacity Designed	Belt width
Receiving Apron Conveyor 12'-0" x 64'-0"	Gulf 74-6	2	1/3 - 3	23¼	2 - 20	50 TPH	12'0"
Oscillating Conveyor 63" wide x 18" deep x 20'0" long	Link-Belt 74-22	10	200 cycles per min. 7/8" stroke			20 TPH	
Picking Belt Conveyor 60" x 83'-0"	Gulf 74-23	5	5 - 15	24	30 - 90	40 TPH	60"
Newsprint Conveyor 48" x 16'-0"	Gulf 74-42	1	25	12	78	40 TPH	48"
Cardboard Conveyor 28" x 16'-0"	Gulf 74-41	1	25	12	78	40 TPH	48"
Collector Conveyor 36" x 15'-0"	Gulf 74-43	1	25	12	78	30	36"
Baler (bale size 30" x 36" x 60" long)	Maren 72-5	15				(5) bales (900-1000lbs) per hr.	
Crusher Disintegrator	Centriblast (Joy) CDM-4830-HD	300	1000 RPM Hammer Shaft			20 TPH	
Crusher Section (2) Apron Conveyors 48" x 7'-0" Each of (2)		7½	11.25 RPM Star Shaft	12.94 Apron Sprocket	46.2	20 TPH	48"
		7½	13.5 RPM Driven Shaft Each Apron	12.94 "	46.2		
Belt Slinger 36" wide	Stephens - Adamson 36" Car Loader	7½	520-1560	10	1357-4071	20 TPH	36"

APPENDIX A - MACHINERY AND EQUIPMENT SPECIFICATION TABLE - 1.

Description and Size	Manufacturer or Supplier & Model No.	H.P.	RPM of Screw, driver or head pulley	Dia. in inches of head pulley or screw	Belt Speed in feet per minute	Capacity Designed for	Belt Width
(4) Centrifugal fans on ballistic separator	Sheldons No.13 W/xB Wheel	15 15 15 15	613 - 1560	12		10,000 cfm at 9" SPH_2O	
Non-compostable or Upper Discharge Belt 30" x 23'-0"	Gulf 74-25	1	38	14	106	50 TPH	30"
Intermediate or lower discharge belt 60" x 46'-0"	Gulf 74-24	5	30	20	150	45 TPH	60"
Secondary Grinder	Williams GA 70	400	1200			20 TPH	
Mixing Screws (2) 34" x 12'-0"	Gulf 74-29	3 3	45 45	16 16		30 TPH	
Transfer Belt 30" x 36'-0"	Gulf 74-30	2	56	18	260	60 TPH	30"
Magnetic Separator	Eriez SE-1300	3		24			30"
Can Conveyor 12" x 48'-0"	Gulf 74-31	2	33	12	100	24 TPH	12"
Can Conveyor 16" x 40'-0"	Gulf 74-28	2	33	12	100	30 TPH	16"
Stainless Steel Woven Belt 24" x 18'-0"	Gulf 76-80	1/3	3	12	3	2 TPH	24"
Metal Pelletizer	Noll CM - 300 - S	30	3500			800 Lb/hr.	
Cleated Belt Conveyor 18" x 47'-0"	Gulf 77-8	2	64	14	251	2 TPH	18"

Description and Size	Manufacturer or Supplier & Model No.	H.P.	RPM of Screw, driver or head pulley	Dia. in inches of head pulley or screw	Belt speed in feet per minute	Capacity Designed for	Belt Width
Ferrous Non-Ferrous Magnetic Separator 24" x 36" long	Gulf 79-11	2	52	18	250	10 TPH	24"
Induced Draft Fan for Burner	Sheldons Utility Fan 182, Type B	3	3.75" @ 1800 RPM	5.75" @ 1165 RPM		1900 cfm, 1000 fpm, Outlet Velocity @ 1-3/4" SPH_2O	
Burner Exhaust Fan	Sheldons 29 W/XB Wheel	75	887			19000 cfm @ 10" SPH_2O	
Pump on Scrubber Slurry Tank	Moyno 2D6	2					
Sludge Pump at Sludge Tank	Moyno SWG8	3					
Sludge Aeration Blower	Sutorbuilt No. 3H	3				42 cfm @ 7" SPHg	
Tripper Belt Conveyor 18" x 300'-0"	Gulf	7½			425	20 TPH	18"
Tripper Drive and	Gulf	1			50		
Tripper Shuttle Conveyor 18" x 20'-0"	74-40 (modified Link-Belt)	1	74	12	425	40 TPH	18"
Digester Unloading Belt	Gulf 74-34	2	60	16	250	60 TPH	24"

Description	Manufacturer or Supplier & Model No.	H.P.	RPM of Screw, driver or head pulley	Dia. in inches of head pulley or screw	Belt Speed in feet per minute	Capacity Designed for	Belt Width
Agi-Loader 19'-0" x 19'-0" Apron Conveyor 19'-0" x 19'-0"	Gulf 71-11	7½	4	23½	24	140 TPH	19'-0"
Shuttle Conveyor 24" x 20'-0"		1½	61	12	261	200 TPH	24"
Quick Return		2			Rail Speed 61 fpm		
Forward Feed		1 DC			Rail Speed 9.04"to 30"pm		
Hoist Drive		5					
Final Grinder Feed Belt 24" x 49'-0"	Gulf 74-35	3	60	16	250	60 TPH	24"
Grinder Feed Screw 16" x 24'-0"	Gulf 74-36	3	90	16		40 TPH	
Grinder Regulator Feed Screws 12" x 7'6" (2)	Gulf 74-37	1 1	110 110	12 12		20 TPH 20 TPH	
Final Grinders (2)	Vincent VG 150	150 150	900 900			10 TPH 10	
Grinder Discharge Screw 24" x 20'-0"	Gulf 74-38	5	26	24		40 TPH	
Stockpile Conveyor 18" x 80'-0"	Gulf	5	60	12	250	30 TPH	18"
Air Compressor	Worthington	3					

Description	Manufacturer or Supplier & Model No.	H.P.	RPM of Screw, driver or head pulley	Dia. in inches of head pulley or screw	Belt Speed in feet per minute	Capacity Designed for	Belt Width
Agi-Loader Transfer Car	Gulf	3			90 fpm Rail Speed		
Building Ventilator Fans (3)	Ilg. U-PDE 485	5	900			30.700cfm@ 1/8"SPH_2O	
Digester Blowers (2)	Peerless K1047	15	1750			5,000cfm @ 9.0"SPH_2O	
Grinder Feed Screw Overflow Screw Conveyor 12" x 36'-0"	Link-Belt	5					
Burner (Gas Fired) 9'-6" Dia. x 35'-0" High	Vincent V935					5 tons paper,etc.	
Burner Scrubber	Western Precipitation (Joy) Type C-B Size 16					40,000 cfm @ 1600° F	
Truck Scale	Toledo 2781			60'-0" x 10'-0" Platform		50 Ton	

PERSONNEL CHART

GAINESVILLE MUNICIPAL WASTE CONVERSION AUTHORITY, INC.

Classification and Position	Duties	No. of Persons	Basis and Rate of Compensation	
			Hourly	Monthly
Management and Office				
Project Director	Overall Management	1		$1,000.00
Plant Superintendent	Plant Operations	1		700.00
Office Manager-Accountant	Office Management Weighing, Books, Records, Reports	1		800.00
Secretary	Weighing, phone, Correspondence, Billing, etc.	1		300.00
		4		
Plant Operations				
Machine Operators	Front-end Loader	1	1.85	
	Baler-Fork Lift	1	1.85	
	Console	1	1.85	
	Truck Driver	1	1.85	
	Agi-Loader	1	1.80	
	Tripper	1	1.80	
	Final grind	1	1.80	
	Burner-Pelletizer	1	1.80	
		8		
Maintenance	Foreman	1	3.75	
	Asst. Foreman	1	3.50	
	General	1	3.25	
	Helper	1	2.00	
	Electrician	1	3.50	
		5		
Utility	Sorters	6	1.60	
	General	2	1.60	
		8		
		25		

APPENDIX B

MAJOR LABORATORY EQUIPMENT

Item	Manufacturer	Model No.
1. Drying Oven	Precision Thelco	27
2. Analytical balance	Mettler	H-15
3. Water Still	Barnstead	EMH-5
4. Water Bath	Precision	66634
5. Steam Generator	Amsco	LB20
6. Glassware washer	Heinicke	HW200S
7. pH Meter	Sargent	PL(No. 30008)
8. Kjeldahl Unit	Labconco	20701
9. Moisture Balance	Obaus	6010
10. Induction Furnace	Leco	521-000
11. Klett Industrial Model	Klett	900-3
12. Autoclave	Scanlan Morris	A-422
13. Incubators (2)*	Precision Thelco	4

* Environmental Engineering, Inc. property.

PROCESS INSTRUMENTATION SYSTEMS COMPONENTS

1. Ground refuse moisture control

   Conductivity between two electrodes comprising one leg of an A.C. bridge circuit is recorded on a Model Y15201316-01 Honeywell Recorder.

II. Temperature recording system for refuse digester tanks

   A. 8 Model ID10B24-3, Type T, Honeywell Thermocouples

   B. Model 16303846-508, Type T, 0-200°F, 8 point temperature recorder by Honeywell.

III Mobile Instrument Console

   A. Model 15305826-20, Type T, 0-200°F, 20-point temperature recorder by Honeywell for recording temperature registered on probes.

   B. 10 Honeywell, Type T, resistance bulb thermometers RTB for probes.

   C. Model Y15303826-(20), 20-point Honeywell recorder for recording Analytical data.

   D. Model F3MB-1AA, Beckman O_2 Analyzer with 0-5%, 0-10%, and 0-25% full scale O_2 concentration.

   E. Model 315 Beckman non-dispersive IR CO_2 analyzer.

   F. 2 Model 30000 Honeywell MV/1 transmitters for converting signal from CO_2 and O_2 analyzers.

   G. Model SSP129D021 dew probe by Honeywell.

   H. Model 70919-1 RTB for ambient air temperature

   I. Model 30020 MV/1 transmitter for converting signal from G & H.

   J. 16 Model 160-8CF, F.W. Dwyer pitot tubes

   K. Model 252.0:D2:0 Hayes differential pressure transmitter with 0-5" H_2O pressure differential range.

   L. Model SC330A Rochester square root converted to convert signal from K.

APPENDIX D

THE SANITARY CODE OF FLORIDA
Chapter 170C-10.09
Composting

(1) Standards - In view of the lack of precise definition of design criteria, proposed composting plants shall be reviewed in light of information presented to the board and other information available.

(2) Approval - It shall be unlawful for any person, persons, firm, corporation, company, institution, municipality or community to install or alter composting plants without first having received approval from the board. Plans and accompanying documents for composting plants shall be submitted to the board, through the local health department of the county involved, for review and consideration of approval.

(3) Application - Upon request, the board shall provide application forms and data sheets necessary for board approval. All applications shall be submitted in quadruplicate and shall contain the following information:

(a) A statement that plans for the project have been approved by the governing body of the applicant.

(b) Prints of drawings of the work project which contain sufficient detail to clearly appraise the board of the work to be undertaken.

(c) Data Sheets.

(d) Such additional data as may be requested by the board after initial application for purpose of clarification, anticipated use or to support any changes in the scope of the project, actual or anticipated.

(4) Products - Offered for sale shall contain no pathogenic organisms, shall not re-heat upon standing, shall cause no odors and shall contain no sharp particles which would cause injury to personnel handling the compost. By-products removed shall be handled in a sanitary manner.

APPENDIX E

INTERIM REPORT

January - April, 1968

GAINESVILLE MUNICIPAL WASTE CONVERSION AUTHORITY, INC.

Re: DEMONSTRATION GRANT NO. 5-DOI-UI-00030-03

GAINESVILLE COMPOST PLANT

Submitted to

U.S. PUBLIC HEALTH SERVICE
SOLID WASTES PROGRAM
DEPARTMENT OF HEALTH, EDUCATION & WELFARE

Composting Systems

GAINESVILLE MUNICIPAL WASTE
CONVERSION AUTHORITY, INC. • P.O. BOX 1152 • GAINESVILLE, FLORIDA 32601 • 904 • 372-4275

July 3, 1968

Mr. John A. Ruf, Project Officer
Demonstration Grants Activities
Solid Wastes Program
Dept. of Health, Education & Welfare
222 E. Central Parkway
Cincinnati, Ohio 45202

Dear Mr. Ruf:

We are submitting to you an Interim Report of our progress covering the months of January through April, 1968.

Since this first four months has been basically a shake-down period, we have not been able to present all the information you have asked for in your letter of February 20, 1968. However, we have tried to outline some of the operational difficulties and report on each major piece of equipment as requested.

You will also find technical data developed by Environmental Engineering a part of this report.

Respectfully submitted,

GAINESVILLE MUNICIPAL WASTE
CONVERSION AUTHORITY, INC.

H. W. Houston

H. W. Houston, Project Director

HWH:jb

CABLE ADDRESS • METROWASTE

INTERIM REPORT

January, 1968 - April, 1968

TABLE OF CONTENTS

ITEM PAGE

-I- FINAL PHASES OF CONSTRUCTION 1

-II- SHAKE-DOWN PERIOD

A. Initial Start-up 1
B. Target Date 2

-III- OPERATIONAL DIFFICULTIES

A. Personnel Problems 4
B. Mechanical Problems 5
C. Safety Problems 6

-IV- REPORT ON EQUIPMENT

A. Truck Scale 7
B. Apron Conveyor 8
C. Oscillating Conveyor 9
D. Sorting Conveyor 9
E. Paper Salvage System 10
F. Primary Grinder (Centriblast) 11

    1. Hammers 11
    2. Capacity 14
    3. Dirt Problem 14
    4. Bearing Problems 16
    5. Electrical Problems 17
    6. Miscellaneous Items 18
    7. Major Modification (change over to new Hammer and Star Shaft) 19
    8. Summary 19

G. Ballistic Separator

    1. Ballistic's 20
    2. Air System 22

H. Intermediate Conveyor 23
I. Secondary Grinder (Williams) 23

ITEM PAGE

J. Mixing Screws 25
K. Sludge Tank 25
L. Moyno Pump 25
M. Sludge Aeration System 26
N. Automatic Moisture Sensor 26
O. Transfer Conveyor 26
P. Magnetic Separator 26
Q. Can Conveyor 27
R. Tripper Belt 27
S. Tripper 28
  1. Traction 28
  2. Balance Problem 29
  3. Final Solution 29
T. Agi-Loader 30
U. Digestion Air System 31
V. Finishing System 32
W. Burner 33
X. Metal Pelletizer 34
Y. Motors 34

Z. Rolling Equipment

  1. Front-End Loader 35
  2. Fork Lift 35

-V- IMPLEMENTATION OF BIOLOGICAL PROGRAM

A. Chemical Analysis 36
  1. Sampling Procedure 36
  2. Carbon Analysis 37
  3. Nitrogen Analysis 38
  4. Phosphate and Potassium Analysis 38
B. Microbiological Studies 41
  1. Detailed Methods 41
  2. Sampling Technique and Frequency 41
  3. Routine Coliform Determination 46
  4. Coliform Die-off Study 48
  5. Screening Method for Salmonella 49
  6. Preliminary Bacteriological Results 52
  7. Compost Samples Shipped From Houston and Largo 52
  8. Distribution of Microorganisms in Compost during Digestion at Houston, Texas 53

TABLES

NUMBER	ITEM	PAGE
1.	Carbon Analysis	39
2.	Nitrogen Analysis	40
3.	Microbiological Sampling and Testing Schedule	42
4.	Distribution of Coliforms in Compost Digestion at Houston, Texas	55
5.	Salmonella Presumptives in Houston Ground Garbage	56
6.	Coliform Data on Soil Conditioners	57
7.	Coliform and Fecal Coliforms Found in Compost from Gainesville, Florida, Plant	58
8.	Noise Levels within the Gainesville Plant	68

FIGURES

1.	Flow Sheet for Coliform Determination	43
2.	Flow Sheet for Salmonella Screening	44 45

ITEM PAGE

9. Commerically available Soil Conditions 53
10. Preliminary Data from Gainesville, Florida Plant 54
11. Die Off Study 59
12. Mycology 60

C. Arthropod and Rodent Control Program 61

1. Baits 61
    a. Bait Stations 62
    b. Location of Bait Stations 63
    c. Liquid Baits 63
2. Roaches 64
3. Traps 65
4. Flies 66

D. Occupational Health Program 66

-VI- LIST OF VISITORS TO GAINESVILLE COMPOST PLANT 70

APPENDICES

Appendix	ITEM	PAGE
A	Florida State Board of Health Approval for Scrubber	76
B	Processing and Salvage Charts	
	1. January	78
	2. February	79
	3. March	80
	4. April	81
C	Installation Instruction Sheet Screw Conveyor Discharge	82
D	Installation Instruction Sheets New Hammer and Star Shaft	84
E	Letter of Approval on Hammer and Star Shaft Installation	87

-I- FINAL PHASES OF CONSTRUCTION

The end of December, 1967 saw the basic plant pretty well completed except for a few minor items of equipment and some conveyors being installed. As February came to a close, the construction phase was complete except for the Burner.

The Burner had some design work to be done in connection with the Scrubber. This work was done cooperatively through Metro-Waste, Environmental Engineering and Reynolds, Smith & Hills, architects for the project. The plans and specifications were mailed to the Florida State Board of Health early in March for approval. Copies of the application were also sent to Mr. John Ruf, Project Officer, U. S. Public Health Service, Cincinnati, for his approval.

On March 22, 1968 we received the approval of the Florida State Board of Health under Serial No. INC-424, dated March 22, 1968 subject to certain provisions. (Copy of approval under Appendix A).

Indications from the U. S. Public Health Service are that there may have to be some modifications, but to date no approval has been received.

-II- SHAKE-DOWN PERIOD

A. Initial Start-up: As the different components of machinery were put together, each machine was started up without any loading, to check out its performance. This program was put into operation as early as November, 1967. This also gave personnel assigned to the machinery a chance to get some preliminary experience and training in handling the equipment.

B. Target Date: A target date for trial start up with refuse was set for January 4th. This date was kept as we brought in from the City of Gainesville four trucks with a total of 19.1 tons of refuse. We started operations at 10:30 A.M. with a skeleton crew and, as was expected, everyone was all thumbs. It took a total of 6 hours to grind out this initial load, at the rate of 3.2 tons per hour, while rated capacity to the plant is 20 tons per hour.

An agreement was made with the City during this shake-down period to bring in any number of trucks per day which we felt we could cope with. During January this was done on a daily basis of from 2 to 9 trucks depending on the problems encountered each day. Some days we took in nothing so as to iron out some of the difficulties and make adjustments.

From January on, each succeeding month through April saw an increase in the amount of material processed together with a decrease in the amount of basic problems. The main problems seemed to be confined in about two general areas, namely at the primary grinder and tripper area at the digester tanks. These will be discussed under Section III, Operational Difficulties.

Early in April it was decided that the crew was ready to take full capacity from both City and County, even though we knew we would have to shut down for a period of a week or more to make final modifications on the Primary Grinder. On April 8th we ordered the City to deliver full capacity and on April 9th the County was ordered in. On April 8th we took in 100 tons of refuse, 9th - 114 tons, 10th - 135 tons, 11th - 129 tons and on the 12th - 150 tons. This enabled the whole crew to gain additional experience under the most adverse conditions. It also allowed us to make any necessary adjustments on equipment due to the increase in capacity.

A chart is prepared showing monthly data on the number of trucks received, tons of refuse received, hours grinder mills ran, salvage material pulled, etc This chart is Appendix B.

It might be stated here that the City of Gainesville has a total of 19 trucks picking up refuse. Three of these are 20 yard Dumpmasters which pick up daily from commercial, industrial and apartment areas. The balance of the trucks are 20 yard Rear Loaders and pick up mixed domestic refuse daily except Wednesday. On Wednesday these trucks pick up trash, including leaves, grass clippings, brush, tree stumps and limbs, and any and all household discard items. These consist of old T.V. sets, stoves, refrigerators, furniture, etc The average input by the City to date is approximately 120 tons.

Alachua County uses a private hauler, Mallard Brothers. They use five dump trucks to haul in refuse from the County. This is mostly mixed domestic and trash. A daily average by the County has been 14 tons. Their delivery to the Compost Plant started on April 9th.

The University of Florida has not made any delivery of their refuse to date. However, it is planned to start with them possibly by the 15th of May. The University uses two large packer trucks. One is 65 yard capacity and the other is 45 yard capacity. They will deliver two loads per day, one of each size truck. It is estimated that the capacity of these two trucks will be about 40 tons, of which about 90-95% will be paper.

-III- OPERATIONAL DIFFICULTIES

A. Personnel Problems: Composting being as new as it is, some problems with personnel were expected in the initial phases of the project. This is why it is so essential to have an extended shake-down period.

One of the first problems is for the console operator to learn to control the refuse flow from the Apron Conveyor - Oscillating Conveyor - to the Sorting Conveyor. It is absolutely necessary that a steady, even and uniform thickness flow of the refuse be maintained at all times; first of all to obtain plant capacity and secondly to enable the men on the picking platform to handle the material to best advantage, such as pulling the maximum amount of clean, dry paper and cardboard for baling purposes and also to allow the two men in the final position before the Primary Grinder to pull the maximum amount of tramp metal so as to protect the Primary Grinder from unnecessary damage and wear. It is also essential that the console operator be alert to problems ahead, even as far ahead as the tripper belt, because he has the controls in his hands to stop the flow of material in the event of break-down or unforseen trouble.

The second area of operational problems is on the sorting platform where six men are stationed. These men need to be trained to operate fast and efficiently as the refuse flows before them at a rate of about 30 feet per minute. We have an advantage here in Gainesville in that our buyer of paper and cardboard allows us to bale mixed paper and cardboard. The first four men need training in pulling fairly clean, dry paper and cardboard. It is essential that they learn to work fast and get the maximum amount of paper out for two reasons. First, it provides revenue and secondly, it produces a better grade of compost with less paper going into the digester tanks. The third and fourth men not only pull paper but must be aware of non-compostable items such as plastic, rubber, leather, metal, rags, etc. These are separated and dropped into a chute emptying into a truck to be hauled away to landfill. The fifth and six men must be trained to pull not only non-compostables but also to be alert to detect the presence of tramp metal and pull it out before it falls into the Primary Grinder.

B. Mechanical Problems: With new and unfamiliar machinery it is very important that an alert and well trained crew of maintenance personnel be trained. We are fortunate that a few of the men originally involved in setting up the machinery during the construction phase have stayed on to help maintain the mechanical end of the plant. Preventative maintenance is being practiced to ward off problems before they develop. However, this takes training, so this is another reason it is essential to have an extensive shake-down period. For an example, a definite and planned program of inspection and lubrication has been set up for each piece of equipment. This program was outlined in the annual report for 1967, and has been put into operation during our shake-down period as a part of our preventive maintenance program.

C. Safety Problems: As in any industry, of course, there are many hazards in a plant such as this. Every precaution conceivably possible is being taken to safeguard the men. Guards and screens have been put around head and tail pulleys of the conveyors or wherever there is a chain drive or pulley belt. Rails have been put at all stairs, platforms and pits, and the men are given hard hats to wear while in the plant. Protective glasses are given to the men wherever there is a hazard of flying metal or glass. It has been determined that the noise level is high enough at the sorting area to be a potential danger to the hearing of the men in this area. Therefore, it is planned to furnish the men with a recommended type ear plug.

Many of the safety problems are found on the sorting platform where glass and sharp metal can be a hazard. Gloves are furnished to the men for their protection. There is still one problem that gloves cannot help and this is hypodermic needles which come in from doctors offices or the hospitals. Many times fingers get pricked with these needles and immediately the men are sent to the doctors for a shot. These needles are usually found in blue plastic bags. Since we know this now, we are throwing the whole bag into the non-compostable truck.

-IV- REPORT ON EQUIPMENT

A detailed description of each piece of equipment has been written into the 1967 Annual Report, so the following report will deal mainly with any basic problems, adjustments or alterations we found necessary during the shake-down period for efficient operation.

A. Truck Scale: The Toledo Scale has been in operation since the first part of January when we started up. The main problem we found was getting the scale into balance. Then we had trouble with the card reader dropping figures. As the adding machine punched out the figures, the card reader was not picking them up. Several trips were made by the Toledo people to make adjustments. It was determined that the card reader was an old type which had caused problems before, so a new card reader was ordered for us. As yet, it has not arrived.

The Department of Agriculture of the State of Florida was out on three separate occasions to check out the scale and each time found weight discrepancies. The third time they were out, they stayed with Toledo until the problems had been solved. On April 17, 1968 the scale was approved as being official and the Department of Agriculture Seal was affixed.

There was no problem with service. Anytime a complaint was registered, the local representative in Jacksonville came right away - very often the same day. As of the end of April, the truck scale seems to be working without flaw. There have been no costs involved as far as the Authority is concerned, as everything has been taken care of on warranty.

B. Apron Conveyor: The Apron Conveyor is located within the receiving hopper and conveys the refuse to the Oscillating Conveyor. This piece of equipment has been practically trouble-free through most of the shake-down period. The only problem was a minor one and a matter of learning how to work with it.

The hopper is 12' 6" high. We found that if we load the hopper to full height, then we get a bridging of material at the point where it drops off the apron to the Oscillating Conveyor. The space between the Apron and the side of the Hopper to the Oscillating Conveyor is about 5' 0". A 12 foot wall of material dropping through this point sometimes bridged. The only solution then was to reverse the leads at the motor, backing up the Apron to relieve the pressure and then the refuse falls through. This is not a costly thing to do as it only takes about 5 or 6 minutes, but time is of the essence so we came up with the most logical solution.

We have found the best solution to the problem was to only load the Apron Conveyor as high as it would give a good flow onto the Oscillating Conveyor, this being between 4' and 5' high. Normal refuse is handled very efficiently in this manner but when trash is delivered occasionally long tree limbs will hang up if they are turned the wrong way, and bridge the material. Until we learn how to cope with trash we will still have this problem at least one day a week.

C. Oscillating Conveyor: The basic job for the Oscillator is to distribute an even flow of material onto the sorting belt conveyor. We found one basic problem here and this was ironed out immediately. The Oscillator was equipped with a 10 H.P. motor with 1800 R.P.M. However, with start and stop operation we found the motor was overheating. The 1800 R.P.M. gave too fast a vibration. We installed a new 10 H.P. motor with 1250 R.P.M. and this slowed the vibrator down enough to keep from overheating and still give us a good distribution onto the Sorting Belt Conveyor. The cost of making this change was $215.00 including labor.

D. Sorting Conveyor: This conveyor is fed by the Oscillating Conveyor and feeds the material past the sorting platform where manual separation is done, such as salvaging of paper and cardboard and the picking of non-compostable materials such as plastics, rubber, leather, rags and tramp metal, prior to entering the primary grinder.

The rubber belt has a rather smooth, slick surface when new and this presented a slippage problem to start with. The angle of the belt is rather steep, possibly 45°, and material had a tendency to slip and not climb the slope. When the mass got large and heavy enough it would travel up the incline, but then it was to massive to sort efficiently.

This situation was corrected by fastening 2" wide strips of rubber belting on 8' 0" centers with belt fasteners. Now the material flows up the incline very uniformly without interruption. This change has already saved its cost ($162.59).

E. Paper Salvage System: This system has worked fine with no problems under our present method of operation. The collection conveyors (2) which run underneath the sorting platform carry the paper and cardboard to the baler conveyor. The No. 1 Conveyor was to handle newsprint and No. 2 Conveyor cardboard. When we started, the paper and cardboard were being baled separately. However, there was not enough storage space in either conveyor to hold one kind while another kind was being baled. Additional storage space should be added if separate bales are to be made.

The situation solved itself when our paper customer ordered mixed bales. Our mixed bales weigh an average of about 750 lbs. See Appendix B for quantity of paper baled.

The baling machine itself (Maren Engineering Corp.) has operated without flaw. We have an Automatic Wire Tying Machine to tie the bales with, put out by U. S. Steel Co. The wire is held on four big spools which feed to the baler and are threaded around the bales by hand The tying machine then pulls the wire taut and securely fastens it. This machine is leased by the year at a cost of $148.00.

F. Primary Grinder (Centriblast): The Centriblast is a disintegrator type of mill and is a new type of machine in this field. It was designed to process 20 tons of refuse per hour. As presented to Metropolitan and as demonstrated to them, the Centriblast seemed to have a lot of good potential as related to low maintenance costs and reducing particle size of the refuse. To date the performance of the Centriblast has been disappointing in many respects. We are listing the problems and try to describe the solution to the problems as being worked out by the Centriblast Corp. The engineers at Centriblast are well aware of the problems and have been cooperative in trying to work out the solutions for us.

1. Hammers: The hammers were presented as being a long wearing type with very little wear for a period of several months. The hammers are a stationary type (75 in all) fixed to a solid 6" shaft. These hammers rotate between a "star" shaft above to give a cutting action. These original hammers were made from a metal called "Jalloy #360".

   After the first 126 tons of refuse had passed through, the hammers started to show signs of bad wear which amazed us. The shredding action to start with was very good but the machine would only deliver from 5 to 10 tons per hour at the most without jamming the machine. By the time 360 tons of refuse had run through, the hammers were about shot.

We had complained to the Centriblast people and they sent a representative down to Gainesville with some hard tips to weld onto the hammers and then build up with hard surface welding rod around the tips. These tips were made of Haynes Stellite #6B cut from plate stock and they were in the shape of a triangle. It was recommended by Centriblast that we build up around the tip with "Utectic" 680 and cap with #4IP rod. After another 350-400 tons the hammers again showed extreme wear. It was then suggested that we use another type welding rod that might be harder - namely Certanium #707 - 5/32 @ $8.32 per lb.

The extreme wear continued so some new tips were sent by Centriblast and these were made from nickel manganese metal. This time the build-up around the tips was with Certanium rod #707 1/8 @ $8.76 per lb., #222 3/16 @ $14.85 per lb., and #250 5/32 @ $5.44 per lb. The wear was better, but still needed improvement.

After a meeting with Centriblast and Metropolitan Waste in Pittsburgh, Centriblast agreed to do several things to try and correct the faults of the machine. The prime one, of course, was to manufacture a complete new set of swinging, removable hammers (24 in all) and "Star" shaft. This meant modifying the machine quite extensively. These hammers were about 2" wide and swung between the stars above as before. This time the material used was an alloy with 2% nickel and 15% manganese. Three tool steel hammers were included as a test. The test proved negative as they all shattered when a large piece of 5/8" steel plate went through the mill. The other hammers were not damaged by this impact. Some of the hammers were surfaced with different types of rod such as McKay Hardalloy 58 TIC, Certanium, Colmonoy #1, Special Colmonoy #1, Stoody Tube Borium and Stoody #21, before installation to see which material would stand up the best. Other hammers were left bare.

It is too early to tell the results as only about 200 tons had been run through by the end of April. Further details will be made in the next Report.

While tips and inserts were furnished by the manufacturer for the hammer work prior to the new shaft installation, all of the labor and welding equipment was furnished by the Authority. There were other costs involved in connection with the hammers. The main shaft bent under load pressure and metal passing through and jamming up the hammers. The total cost to the Authority, including removing of the shaft for straightening, came to $2,578.99.

2. Capacity: The Centriblast, along with our other equipment, was designed for 20 tons per hour as mentioned before; however, the output to start with was only averaging between 5-10 tons per hour and this presented a serious problem.

   Centriblast engineers suggested we open up the spacing between the hammers and the"star" shaft and this would enable more refuse to pass through. And this is exactly what it did - pass through with hardly any shredding action. The opening was increased 2 inches so there was less engagement between the hammer and star shaft. The capacity did increase to an average of from 12-15 tons per hour depending on the weight of the material. We figured the Secondary Grinder would reduce the particle size for us. It was also assumed that with the new hammers coming, capacity would increase to the fullest and particle size would be reduced.

3. Dirt Problem: The Centriblast turned out to be a dirty machine, dropping out refuse and trash from underneath the lower apron feed conveyor. Particularly

on trash day this was apparent as it put as many leaves on the floor as it passed through the machine. We could not live with this, of course, as it presented a constant clean-up problem all day long.

The solution here, as again suggested by Centriblast Engineers, was to install a screw below, which would feed onto the Intermediate Belt going to the Secondary Grinder. A hopper was built from the bottom of the Centriblast frame down to the screw to catch all material falling through. Basically, this solved the dirt problem,but the screw hung up and stopped under heavy loading. The screw came from Centriblast equipped with a 1 H.P. motor. We solved this problem ourselves by installing a 2 H.P. motor and a double belt drive in lieu of a single belt furnished. Now we virtually have no problems in this area.

The screw and motor were furnished by Centriblast for this change, however, there was a lot of modification needed to make this change. Beams had to be altered and relocated, the feed conveyor drive motor and chain had to be changed from under the machine to the outside, and a heavy beam installed to support the new hammer shaft. All the labor and construction material was furnished by the Authority at a cost of $1,619.88. An installation sheet (Appendix C) is enclosed to show the extent of the work involved.

4. Bearing Problems: The first problem with the bearings was caused by the bent hammer shaft. As mentioned before, the bent shaft was due to metal getting caught in the hammers. The way the machine was designed, this shouldn't have happened. A hydraulic system should have opened the jaws of the machine under load conditions and passed the metal through. The bent shaft caused excessive vibration, which caused overheating of the bearings.

The situation was probably aggravated by the presence of dirt in the bearings. The construction of the Centriblast is such that the bearings are jammed tight against the housing. Due to the dirty nature of the machine, sand and dust are forced out of the Centriblast at the bearings under pressure and works its way through the seals. We have had to change oil and flush the bearings out as often as 3 to 4 times a week which is far more than necessary under normal conditions.

Under these condtions, the bearings were burned out. The housings were in good condition, but the bearings themselves had to be replaced. These bearings should have been able to withstand 200° F. temperatures, but they heated up to 250° F. One other bearing was burned out before making the transition to the new hammer shaft.

When the new hammer shaft was made, it would have been better to have had a longer shaft so that the bearings could have been mounted out at least six inches from the machine. As it was, we were only able to set the bearings out about one inch on each side. Centriblast came out with a better seal to try to keep dirt from penetrating. The new hammers also reduced the R.P.M. ratio from 1500 to about 1200. The bearings were watched closely when the new set-up went into operation. Temperatures were checked closely and found to be running between 135° to 150° F. We changed the oil frequently and found it to be fairly clean so we know the new seals are working more efficiently. To date, the bearing problem has cost us a total of $2,341.24.

5. Electrical Problems: To start with, we had some serious electrical problems. We found that the safety on the Westinghouse controls was not cutting the 300 H.P. motor off when it stalled under a load. A couple of times the motor sat there and smoked. Fortunately someone was close by and shut the motor off manually and saved the motor from permanent damage. Westinghouse came out several times to adjust, but it didn't seem to make much difference. A new timing relay was sent to us by Westinghouse to install and set for eight seconds. This could be adjusted again

if we found it shut off too frequently.

We found that the thing that actually helped the most was opening up the machine, as this prevented any further jamming problems. With the new hammer set-up, we have not encountered this problem at all. On the old hammers amp readings went as high as 90, while the operation to date with the new hammers has never gone over 25 amps, as shown by a recording chart installed by Centriblast. Actual costs incurred because of electric problems have been $450.95.

6. Miscellaneous Items: These items consist of various problems relating to the Centriblast, the main one being the lower feed conveyor. The metal plates on the conveyor were too light weight causing the conveyor to jam on jumerous occasions due to their bending. This, of course, caused down time as the maintenance men had to cut these plates out with a torch. This left more gaps for refuse to fall through. To solve this problem Centriblast sent a new heavy duty track for us to install.

   Other items strictly minor headache problems, such as metal catching in the hammers or star rotor, material jamming in the hammer area or bridging up on ledge just in front of the hammer shaft. They all caused down time and were expensive to cope with. Total miscellaneous labor and material costs have been $850.27.

7. Major Modification: (Change over to new Hammer and Star Shaft) This change required considerable work on our part, and eleven days down time, which was costly. Several modifications had to be made. Installation sheet is enclosed (Appendix D) to show the extent of the work involved. During this major modification Centriblast had a representative on site, Mr. Arno Liebman, to supervise the overall work. The total cost to us on this phase of the work amounted to $2,100.48.

8. Summary: A lot of work has been done on maintenance and modifications and a lot of money spent. The total outlay of money expended by the Authority, not including the parts furnished by Centriblast, has been $9,906.81 through the end of April. The Centriblast will be watched closely from here on out to determine if the machine is going to perform up to specifications. A lot of revenue has been lost due to the poor performance up to date. While we have been unable to perform with any consistancy at all the first four months of the year, we have lost at least two months of revenue, amounting to $12,000, from the participants in the project - namely the City of Gainesville, the University of Florida and Alachua County.

G. Ballistic Separator: The basic principal of the Ballistic Separator was to separate metal from compostables. In theory, heavier metal particles would project out and land on a top belt or conveyor to be removed before entering the Secondary Grinder. The other portion of this separator was a pneumatic air system to draw out paper and plastics and transport them to a burner to be used as fuel for burning and purifying the metal. The paper removal would also serve a dual purpose in that it would reduce the amount going into the digestion tanks, which is desirable.

1. Ballistics: There is a slinger at the bottom of a chute from the opening of the Centriblast. The principal of this is to catch heavy metal dropping from the Centriblast and to sling it up to the top metal belt. Also, materials such as paper and garbage, being lighter in weight, would be projected out onto the compostable belt. The Separator came with a solid baffle plate located about midway in the housing. The top third of this plate was adjustable in that it would slide forward or backward. In our first test, the adjustable part of the baffle was left straight up and we found some metal and quite a bit of paper and garbage was going onto the metal reject conveyor. So the baffle plate was adjusted both ways but with no improvement.

   We found another problem was that the chute down to the slinger narrowed to guide material into the slinger. When bulky material such as tree limbs and brush fell into the slinger from the Centriblast it caught and then backed all the way up to the Centriblast, jamming it. This was mainly because the Centriblast did not do an adequate job of grinding or shreading. This happened on numerous occasions and became quite a problem.

Next we removed the baffle and relocated it to just in front of the can reject belt. It was adjusted to several heights to try to get a good metal separation, but when it was too low we got too much garbage and paper with the cans. When set higher, we eliminated the paper but got very little metal.

We tried regulating the slinger to throw the material at a different angle. However, this did not do anything for us but cause a few more problems. When the slinger was set at its extreme point to toss the metal higher, it apparently put a strain on the belt to the point it jumped off the roller. This is a 30" wide belt. It happened about three times and each time stretched the belt so that it would not track properly. It got so that it was happening every 20 or 30 minutes, so we could not stand the down time.

It was decided to remove the slinger on approval from

Mr. Victor Brown of Metropolitan Waste Conversion Corporation, who was here at the time. At the same time we widened the chute from the Centriblast to the Intermediate Belt, which eliminated a big bottle neck of material jamming up. This was particularly true on trash day. Labor and material to date in adjusting and altering the Ballistic Separator to try and get better results has been $410.35.

2. Air System: The air system has been tried experimentally. The original system had a blower outlet at the top and another one at the top left side, both of these for drawing paper and plastics out. Two openings were installed at the bottom on an angle with the chute coming off of the Centriblast. Part of the function here was to keep the chute cleaned out and free of trash and also to keep paper and plastic air borne so that more could be drawn out in the top tubes. When the slinger was removed and a new wide chute was installed, the two bottom blowers were removed temporarily. Because the Burner is not ready to operate, due to the Scrubber installation being incomplete, we have been able to do very little experimental work. The blowers have variable speed drives and we have run these blowers at the slowest speed and fastest speed. At the fastest speed we found we were only drawing 320# of shreaded paper into the Burner per hour. Without being able to burn,

its hard to tell what this amount of paper will do for us heat-wise. We intend to place one of the blowers back at the bottom to experiment with, and again check out the variation in weight of paper we might be able to get to the Burner per hour.

H. Intermediate Conveyor: This conveyor is located at the bottom of the Ballistic Separator. It runs on an incline and feeds compostable materials into the top of the Secondary Grinder. The belt is five feet wide. This conveyor has done its job adequately with no problems or expense to date.

I. Secondary Grinder: The Williams Hammer Mill - Model GA-70 - has been a very functional machine up to the present time. Because of the lack of capacity produced by the Centriblast, the Williams has really not had to work hard. We have had no basic problems though, except at the very beginning when one bearing on the drive side leaked badly and heated up. The Williams people came down to Gainesville from St. Louis and brought a new seal for the bearing and to check the machine out. They admitted a faulty seal was in the bearing. It cost us $222.87 to fix this and we are trying to recoup this cost from the Williams Company.

The rest of the work on the Williams has been strictly maintenance, such as lubrication and changing hammers. An extra set of hammers was ordered for obvious reasons. There are 26 center hammers and 4 end hammers made of "M" alloy. The cost of the extra set was $828.12. Each of the center hammers weighs about 50 lbs. plus or minus 2 lbs.

The hammers were changed the first time after grinding 1000 tons of refuse. This was on the original hammer surface. The first set of hammers were capped or built up with two types of hard surface rods. The first build-up was with Certanium #707 costing $7.51 per pound. This was capped with Certanium #222 at $13.78 per pound. These hammers lasted for 805 tons before changing again. The cost of the Certanium rods for this first welding operation comes to $944.06 plus 39 hours of labor at $3.50 per hour or $136.50 for a total cost of $1,080.56. For 805 tons, the cost per ton for grinding would be $1.34. We had purchased this hardface rod specifically for the Centriblast hammers at their request so thought we would try them out on or other hammers as well.

The second time we welded the Williams hammers we tried a different approach, using a much less expensive rod. An average of 3 lbs. of No. 118 McKay rod ($.66 per lb.) per hammer was capped with an average of 1 lb. of BX Ranite rod ($1.40 lb.) per hammer. The total cost for a set of hammers on this basis was $92.12 plus the labor cost of $136.50 or a total cost of $228.62. This set of hammers had to be changed at 625 tons, so the cost per ton on this set is $.37 per ton.

The conclusion of course, at this point is obvious; but as this is a demonstration plant, we felt it necessary to try the so-called better rod out for wearing quality. We will have tried other low cost rods by the next report.

J. Mixing Screws: The mixing screws are located directly under the Secondary Grinder and the primary function is to mix the ground refuse with moisture in the form of water or sewage sludge and move it onto the transfer belt. The mixing screws have functioned very well on the whole, except for one or two times when the screws became overloaded. The belt would turn and burn while the screw remained stationary, so a belt would have to be replaced. Then occasionally the screws have to be cleaned up by removing rags and wire which have gotten tangled up in them.

K. Sludge Tank: To date the sludge tank has been used exclusively as a water reservoir and is run into the plant through the Moyno Pump into the mixing screws. The city has not as yet constructed their line over to us, therefore, we are unable to use sludge at this time. We did attempt to fill the sludge tank by pumping from a tank car the city sent to us. We had a Moyno Pump to pump from the truck into the tank, which due to a capacity of about 20 gallons per minute, was inadequate. The city could not tie up the man and truck long enough to supply us with enough sludge. We took in 6000 gallons of sludge with 3% solids and then went back to using water.

L. Moyno Pump: The moyno delivers the water and/or sewage sludge to the mixing screws. Other than a faulty shaft which was cracked and broken and was covered under warranty, there have been no basic problems with this pump. We do get a flow of water at the screws after the pump is shut off, but this is a drainage of the pipe which creates a bit of a mess. This is being handled by the installation of a solenoid valve to make a positive shut-off. This is not done yet, but is in the process.

M. Sludge Aeration System (Sutorbilt Blower): As no appreciable amount of sludge has been used to date, it is hard to evaluate the efficiency of this pump. No problems to date.

N. Automatic Moisture Sensor (Honeywell): We have been experimenting with this system to some extent, but finalization has not been made yet. Due to the inconsistancy of the flow of material, it has been hard to adjust the system, therefore; we will need more time to evaluate the system.

O. Transfer Conveyor: This is the belt which passes ground, moist refuse from the mixing screws to the tripper belt and under the magnetic separator. This conveyor has operated efficiently and after installing overflow skirts, the area around the belt is a lot cleaner.

P. Magnetic Separator: The magnet pulls out the ferrous metal before the material enters the digestion tanks. It does a good job except for a small amount of aluminum which sneaks by into the tanks. There has been no maintenance expense to date on this Eriez Magnet.

Q. Can Conveyor: There is a 12 inch can conveyor from the magnet to the Ballistic Can Belt and from there it increases in size to a 16 inch conveyor. Each of these conveyors runs on a separate 1 H.P. motor. At one time each of the belts jammed up with metal and both motors burned out. We found this was due to the undersized heaters which failed to cut the motors off in time to prevent damage. The electric contractor stood the cost of having the motors rewound. Other than this, these two conveyors have operated satisfactorily.

R. Tripper Belt: The tripper belt conveys the ground refuse to the tripper where it is discharged into the digestion tanks. It also carries the digested compost from the storage tanks to the regrind area for a final grinding. The tripper belt as an operation has functioned properly, but we have found this 18 inch belt to be undersize. The problem here being a constant clean-up problem due to material falling off the belt the full length of the digester tanks. Not only was this true of ground refuse going into the tank, but also of digested refuse being removed and transported to the regrind area.

Another problem area was at the tail end of the belt where material fell from the transfer belt. With the 18 inch belt, the material had a tendency to build up, especially when extra wet; and it generally took an extra man in this area to keep the belt cleared.

The belt developed some weak spots and it was hard to trail because it was stretching and as spots got too bad, splicing was done in order to keep running. Two or three rollers have had to be replaced because of bad bearings. Also a new tail pulley was installed of the self cleaning type to prevent a build-up of material under the belt. The solution to the problem would be a new 22 inch belt the full length of the tripper. Costs to date for miscellaneous repairs and labor have been $410.98.

S. Tripper: The tripper moves back and forth between the two digester tanks with the prime function of distributing the ground refuse into the tanks. This has been one of our major problem, not that they were expensive problems, but they had a lot of nuisance value to them. Some of the problems and the attempted solutions follow:

1. Traction: When material would get on the tracks, the drive wheels would spin without moving the tripper and it is important for the tripper to move in order to distribute the material properly. This problem also existed when the shuttle conveyor was fully extended to either side. The weight of the shuttle had a tendency to tip the tripper so that one side had no traction.

   Solution: We attempted to help this situation out by relocating the rear wheels to try to get better weight balance. This didn't seem to help. We tried to keep the tracks clear of material to prevent slippage, but this didn't seem to help. The only time the tripper ran properly was when the shuttle was in the center of the track.

2. Balance Problem: As mentioned above, the weight of the shuttle fully extended had a tendency to tip the tripper off the tracks.

   Solution: Install Yale Trolleys on the tripper which grip under the track to keep it from tipping. This did not solve the slippage problem. With the balance problem, these trolleys had a tendency to wear out fast and had to be replaced frequently.

3. Final Solution: These problems were with us constantly. Costs for the adjustments mentioned above amounted to $171.41. It was decided to make a major modification on the tripper while we were down for the Centriblast modifications. The whole front end of the tripper was removed and redesigned. Instead of the shuttle running perpendicular to the tripper and moving back and forth by a hand wench, it was constructed on a swivel of much lighter material. It can now swivel from a 90° angle on the right side to a 90° angle on the left or a full 180° swing. At the same time, a four wheel drive was installed. The weight of the shuttle is now 1400 lbs. less than

originally. It is a much improved piece of equipment in that it is simpler to operate, gives a positive drive (no slippage as before) and no tendency to leave the track. The total cost of the modification was $1,007.85 for labor and material and worth every penny of it.

T. Agi-Loader: The Agi-Loader has a dual function - that of agitating or turning over the digesting material and also unloading this material after a digestion period of six days.

Basically the machine has functioned fairly well outside of what we would classify minor problems to iron out during a shake-down period. One of the problems was the constant breakage of the cables which raise and lower the apron conveyor. We felt this was a manufacturers problem and the cable should have been a heavier weight. It should also have been constructed in such a way to prevent this cable from rubbing on the side of the apron which no doubt wore the cable out. Therefore, we fixed the problem and are trying to pass along the cost to Gulf Machinery Corp. Our cost of fixing this was $243.19.

Another problem was that the apron conveyor, when digging into the compost, did not pick up enough material so this was solved by installing 1½" x 1½' angle irons about every six to eight cards in staggered positions. Therefore, more material was picked up as it traveled through the compost.

To start with, we lowered the apron of the Agi-Loader all the way to the digester floor when we wanted to unload. However, we found this created quite a load on the machines ability to move forward into a full wall of compost without blowing fuses all the time. The other problem with cutting into a nine foot wall of compost was that too much compost fell onto the apron causing an overload of material out at the regrind mills and jamming the mills. To avoid both problems, we now cut into the pile about one-third at a time and find that this works for a much smoother operation.

Other problems have strictly been a matter of minor adjustment. A quick return motor which moves the machine backwards faster was burned out due to overfusing, of which we were not aware. This has been corrected.

U. Digestion Air System: The air system is, of course, the critical part of our process in that its job is to keep the compost in an aerobic state. Therefore, we must keep enough air moving into the false floor of the digestion tanks. We can keep pretty close tab on this by observing the temperatures recorded on a recording instrument manufactured by Honeywell. The temperatures are in a basic range of 150° F. to 170° F. indicating an aerobic condition. When an anaerobic condition exists (foul odor) invariably the temperatures will be well below 130° F., indicating lack of oxygen. This has happened a time or two, but it was quickly determined that the blower had cut off leaving us without a supply of air.

While the specifications call for the air to be on 1½ minutes out of every 15 to each tank, we have found the temperatures rise faster and higher if more air is supplied and at the same time, it is built-in protection against going anaerobic. We have been running as much as sixteen minutes of air into the tanks per hour.

V. Finishing System: The finishing system consists of a series of unloading conveyors and screws leading to the regrind machines, of which there are two. When the tripper belt is unloading digested compost. it is dropped onto a conveyor belt which carries it to an incline conveyor, which in turn delivers the material to an 18" screw located high above and running parallel with the regrinders. This screw has 2 cut-outs on the bottom which drops material into two 12" screws and each one of these 12" screws drops material into a machine for final grinding. After regrinding, the material drops into a 24" screw and carries it out to an incline belt, which in turn carries it out to the bulk storage area for further aging. This whole system, of course, is dependent upon an even flow of material in the right amount to prevent any one of the components from jamming up. It is possible for an operator to plug up one of the screws and either or both of the regrind mills, if he is not alert. Here again this is a matter of training and experience.

There are 18 hammers to a set in each regrind mill - 14" long, 4" wide, 1" thick and weighing 12 lbs. each. We have been using the same rod for building up these hammers as we use for the Williams hammers. It takes a maximum of about 3 lbs. of rods for a build up, so at this rate it costs $45.90 for material and $40.50 for labor or a total cost of $86.40 per set. One problem which persists is the large percentage of screens which get damaged. A set of screens is made from 1/4" plate with 9/16" round holes. These screens are in the form of a 180° arc and when a pair is installed form a circle. A pair of screens cost $90.00. The hammers are set up on a vertical shaft and swing horizontally within this circle. The closeness of the hammers to the screens, together with a lot of sand in the material seems to wear the hammers out quite rapidly. We have not established how many tons per hour we get on a set of hammers, but this will come out in the next report. Screens can sometimes be repaired, so are not always a total loss. There is always a certain amount of metal which comes through with the compost to be reground. This is mostly aluminum, but there is also an occasional piece of steel which gets into the compost, and this is what tears the screens up.

W. Burner: The Burner, while in place and ready to run, has not been put into operation as yet due to the fact the Scrubber System has yet to be installed. The primary purpose of this system is to burn the impurities out of and off of the metal cans so they will be more marketable. So for the time being, we are unable to do anything with the tin cans except to haul them out to the landfill dump.

X. Metal Pelletizer: After burning the metal it passes into a Pelletizer. The prime purpose of this is to reduce the size of the metal to allow more weight to be stored in a relatively small storage area. While we have not burned the metal, we have tried to pelletize with not much success. This is a Noll Mill - Model CM-300-S - and seems inadequate to do the job. The main problem seems to be that it is underpowered for the type of material it has to take. A rotor with 6 blades turns at the rate of 3400 R.P.M. and forces the metal through perforations in a removable liner. However, the metal jams in the liner and stalls the mill. The Noll Engineering Company has sent new type screens, but with no more success. The screens get torn up. Now they have sent a new rotor to try out. The liners have been torn, up so until we get a new set of lines we cannot operate again. We are waiting presently for these. Further evaluation will be made after we are able to put the mill back into operation.

Y. Motors (In general): On a whole,most motors have functioned properly except as mentioned under the report on Centriblast. We found some motors were too small for the job. Either they kick off too often or they have burned out. For example, the feed screws into the two Final Grinders were 1.H.P. motors and these kept burning out. These were changed to fully enclosed 2 H.P. motors and we have not had any more problems.

A general comment about the motors would be, that due to the dirt and dust problems in a plant of this type, all motors should be a fully enclosed type.

Z. Rolling Equipment:

1. Front End Loader: We are using a Caterpillar Model 922B with a 3 cubic yard bucket. This machine was purchased at a price of $17,750.00 and is equipped with a diesel engine, a 24 volt direct electric starting system, blower fan, power shift transmission, torque converter, hydraulic boosted steering and brakes, fenders, lighting system and counterweights. Super steel guard tires (17.5 x 25 - 12 ply) by Goodyear were used. This is a cut-proof tire and we have had excellent service with these. The tread wears fast but the body is tough and withstands all the broken glass we ride over all day long. We have yet to have a flat with these tires. The short life of the tread is due, of course, to the type of service it is subjected to.

   The machine itself has given good, low cost service, as we have had no maintenance problems other than normal lubrication.

2. Fork Lift: We are using a Hyster Fork Lift Model S-30-A, which is equipped with Cascade Cotton Clamps for picking up our paper bales. The Hyster is run

with LP gas, has power steering and overhead guard and has a lifting height of 119". The capacity of the machine is 3,000 lbs. It was bought at a cost of $6,899.41.

This machine is used mainly for moving the paper bales into a storage area first and loading on a flat bed truck to haul off to market. It is occasionally used by the maintenance department to lift heavy materials such as hammers. etc. up to the grinders which are elevated. The Hyster has functioned well with no maintenance costs to date.

-V- IMPLEMENTATION OF BIOLOGICAL PROGRAM

(Technical data in connection with this program has been compiled by Environmental Engineering, Inc.)

A. Chemical Analysis: to date we have restricted out analyses to two compost samples, A & B, activated carbon and A.R. grade ammonium chloride. We have done this in order that we might verify the accuracy and precision of our proposed methods before we begin the systematic analytical program. The compost samples are grab samples which were taken from the product pile and over dried. These samples are kept in the desiccator. Individual samples are taken from the desiccator and redried prior to analysis.

1. Sampling Procedure:

a. Raw Refuse

Grab samples taken every two hours from a point beyond the magnetic separator will be composited daily. Percent moisture will be determined on a small portion of each sample. The results of these moisture determinations will be averaged. The remaining portion of the grab samples will be dried, combined and thoroughly mixed in a blender.

b. Product

Grab samples of final ground compost will be taken every two hours. Moisture determination and composite preparation will be the same as for the raw refuse sample.

Composites described above are to be prepared daily. Before a grab sample is taken it must be verified that the plant has been operating at steadystate for at least 10 minutes.

2. Carbon Analysis: We have used the APWA procedure for the determination of carbon with just one modification. The normality of the absorbing solution has been increased from 0.1 to 1.0. This change was made so that we could vary the sample size without saturating the absorber.

The results of carbon analysis are reported in Table 1. Thus far the precision on any given day has been good, with the exception of April 29. On that day there was more variation than any other day and the blank was twice as high as it had been before or has been since. The precision from day to day has been acceptable but not excellent. The percent carbon determined does seem to be independent of sample size.

We have consistently found activated carbon to be only 80 percent carbon. On May 6, we fired some samples of activated carbon at 600°C for 2 hours and found the percent volatile solids to be 96.5. There is good reason to believe that the percent carbon in activated carbon is the range 95-96%. At this time we can offer no explanation for the low results.

3. Nitrogen Analysis: The nitrogen determinations have all been done by the recommended APWA method. Both reproducibility and precision have been good (see Table 2).

4. Phosphate and Potassium Analysis: Attempts to digest compost by the method suggested in the APWA manual have not been successful. Even when the sample size is reduced by 1/2 and the amount of concentrated sulfuric acid is doubled the digestion is not complete. The digestion can be completed if a small amount of mercuric oxide is added but the mercuric oxide reprecipitates when the digested solution is neutralized. The solution must be filtered after neutralization in any case, but the mercuric oxide substantially increases the time required. We intend to try a

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CARBON ANALYSIS

Date	Sample Designation	Number of Samples	Average Sample Size (grams)	Average % Carbon	Standard Deviation
4-19-68	Activated Carbon	5	0.1220	81.3	0.6
4-19-68	Compost A	5	0.5847	34.9	1.7
4-25-68	Activated Carbon	4	0.1684	77.9	1.1
4-25-68	Compost B	4	0.1693	42.1	2.0
4-29-68	Activated Carbon	5	0.0696	84.3	3.8
4-29-68	Compost B	6	0.0824	39.5	4.3
5-1-68	Activated Carbon	5	0.0583	79.6	1.3
5-1-68	Compost B	5	0.0592	38.7	2.3

VOLATILE SOLIDS IN ACTIVATED CARBON

Date	Number of Samples	Average Sample Size	Percent Volatile Solids	Standard Deviation	Percent Ash
5-6-68	5	0.2000	96.5	0.2	3.5

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NITROGEN ANALYSIS

Date	Sample Designation	Number of Samples	Average Sample Size (grams)	Average % Nitrogen	Standard Deviation	C:N Ratio	C:N Ratio With % Carbon adjusted
4-15-68	A	5	3.0748	0.399	0.022	87.5:1	103.9:1
4-19-68	A	5	3.1230	0.360	0.014	96.9:1	115.0:1
4-24-68	B	5	1.4598	0.479	0.044	87.9:1	108.9:1
4-25-68	B	5	1.4675	0.493	0.023	80.1:1	91.7:1
4-29-68	B	8	1.5250	0.497	0.024	77.9:1	94.4:1

RUNS WITH KNOWN AMOUNTS OF NITROGEN

NH_4 Cl Used (mg)	Nitrogen in Sample (mg) (Actual)	Nitrogen found Analytically (mg)	Error	Error As Percent Of Actual Nitrogen	Corresponding Compost Sample Size in Grams (Compost = .5%N)
17.1	4.48	6.31	+1.84	+29.1	0.896
31.2	8.17	9.19	+1.03	+11.3	1.634
60.1	15.73	17.56	+1.83	+10.4	3.146
29.8	7.80	8.37	+ .57	+ 7.3	1.560
30.0	7.85	8.51	+ .66	+ 8.3	1.570
60.8	15.91	17.70	+1.79	+11.2	3.180
60.0	15.70	17.15	+1.45	+ 9.2	3.140
60.2	15.75	18.11	+2.36	+15.0	3.150

sulfuric-nitric acid digestion, and digestion with very small amounts of mercuric oxide. At the time of this writing we are awaiting a replacement motor-blower assembly for the Kjeldahl unit.

B. Microbiological Studies: The microbiological studies at the compost facility will include the detection of total coliform, fecal coliforms and Salmonella in each batch of refuse brought into the plant. Samples will be withdrawn and composites will be made of raw ground refuse as well as finished compost. The sampling protocol will be such that daily composites will be taken from primary ground waste and finished compost coming out of the digester tank. This schedule was established by the Florida State Board of Health who are interested in obtaining sufficient baseline information of the bacteriological content of compost to allow them to make a judgment as to its sanitary quality. Presently we will not have time to assess the numbers or presence of pathological fungi, helminths, parasitic protozoa, or viruses.

1. Detailed Methods: The frequency and sample sizes for each test are given in Table 3. and flow sheets for the coliform and Salmonella tests are shown in Figures 1 and 2.

2. Sampling Technique and Frequency: Composite daily samples are taken of raw refuse after grinding and finished compost by collecting approximately 20 grams

TABLE 3

MICROBIOLOGICAL SAMPLING AND TESTING SCHEDULE

Test	Sampling Points	Sampling Frequency	Size of Sample (wet wt.)	Size of Sub-Sample (wet wt.)	Number of Sub-samples	Differential Media Used
Total Coliforms	After primary grinding and after final grinding	One composite per day from each point	50-60 grams	5 grams	3	Brilliant green lactose broth
Fecal Coliforms	"	"	"	"	"	E.C. medium
Salmonella	"	"	"		5	Phenylalanine agar Simmons Citrate Urea Agar, and "O" group serology

FIGURE I

FLOW SHEET FOR COLIFORM DETERMINATION

Each 5 gram Sub-sample

Prepare Log Dilutions and plant in lactose broth

Incubate 48 hours at 35°C.

gas

Plant loopful into 10 ml. of E. C. medium and brilliant green lactose bile broth

no gas

Negative for coliforms

Brilliant green lactose bile broth

Incubate 48 hours at 35°C.

gas

Positive confirmed test for coliforms calculate MPN/gram of total coliforms.

no gas

Negative for coliforms

E. C. Medium

Incubate 24 hours at -44.5 ± .5°C.

no gas

Negative for fecal coliforms

gas

Positive for fecal coliforms (E. coli strains) Calculate MPN/gram of fecal coliforms.

FIGURE 2

FLOW SHEET FOR *SALMONELLA* SCREENING

Each 5 gram Sub-sample

Plant into ≈25 ml. tetrathionate broth

Incubate 48 hours at 37°C.

Streak two plates of brilliant green agar

Incubate 24 hours at 37°C.

Pink or colorless colonies -
pick to TSI slants (stab and
streak)

Incubate 24 hours at 37°C.

Green colonies -
discard as lactose fermenters

Butt acid yellow
Slant alkaline (red)
and/or H_2S + blackening -

Inoculate
1. Urea agar
2. Phenylalanine agar
3. Simmons citrate agar

Incubate 24 hours at 37°C.

Butt and slant acid (yellow) ·
discard as lactose fermenter

Urea - (no red color) Citrate + blue Phenylalanine - no green color with test reagent Possible *Salmonella*, re-inoculate TSI slant	Urea + (red) Citrate + (blue) Phenylalanine (blue to green pigment and grape like odor) - discard as *Pseudomonas aeruginosa*	Urea ± Citrate ± Phenylalanine + (green with test reagent) - discard as *Providence*	Urea + (red) Citrate + (blue) Phenylalanine ± discard as *Proteus*

FIGURE 2 (Continued)

Incubate 8-24 hours at 37°C.

Proceed with testing for Somatic, "O"
antigens with polyvalent "O" antiserum

Poly "O" positive
(good agglutination)
Test with "O" groups A-I

Poly "O" negative
(no agglutination)
discard as non-Salmonella

Any group positive
(good agglutination)
Probable Salmonella
send culture to CDC
in Atlanta, Ga., for
confirmation

All groups negative -
Test for washing "Vi" antiserum

"Vi" positive -
Boil for 10 minutes to
destroy "Vi" antigen
then test again for "O"
groups A-I

"Vi" negative -
Discard after
repeating biochemica
and serological test
as non-Salmonella

Any "O" group positive -

Probable Salmonella -
send culture to CDC in
Atlanta, Ga., for confirmation.

Negative -

discard as non-Salmonella
after re-testing biochemical
and serologic properties.

of sample every two hours from each station. These samples are then thoroughly mixed and prepared for testing.

a. To collect a sample, sterile tongs are used to transfer material from the conveyor belt to sterile plastic bags.

b. One 20 gram sample is taken every 2 hours at each station.

c. The finished compost is taken immediately following the final grinding.

d. The raw refuse sample is taken from the conveyor belt following primary grinding and addition of water.

3. Routine Coliform Determination. - Multiple tube technique for determining MPN per gram dry weight of coliforms and fecal coliforms.

   a. 50 grams of sample is placed in a sterile blender, 400-600 ml. sterile PO_4 buffered water added (depending on paper content) and the contents blended for 30 seconds.

   b. Three approximately 5.0 gram aliquots are placed in milk dilution bottles containing sterile PO_4 buffered water and log dilutions made to 10^{-8}. The amount of sample going into each bottle is weighed.

c. Portions are planted from the dilution bottles to lactose broth to give a range of sample size from 0.1 ml. to 10^{-8} ml. from the original tube. Five lactose tubes are inoculated for each sample size.

d. 5 portions are taken from the blender and dried for 24 hours at 100°C to determine the percent moisture in the sample.

e. Lactose tubes are incubated 48 hours at 35°C after which transfers are made from lactose tubes showing gas to brilliant green bile lactose broth and E.C. medium.

f. The brilliant green bile lactose broth tubes are read after incubation at 35°C for 48 hours and the E.C. tubes after incubation at 45°C for 24 hours.

g. The MPN for total coliforms is calculated using the data from the brilliant green bile lactose tubes, the MPN for fecal coliforms is calculated from the results on E.C. medium. Values for MPN/100 ml. are found in Standard Methods. To obtain MPN per gram the following conversion is made:

$$\frac{\text{MPN/100 ml.}}{\text{wet weight of sample}} \times \frac{\text{dry weight}}{\text{wet weight}}^{*} = \text{MPN/gram dry weight}$$

$$\frac{\text{dry weight}}{\text{wet weight}}^{*} = \frac{\text{dry weight of sample taken for drying}}{\text{wet weight of sample taken for drying}}$$

Media. -

Lactose Broth - Difco Laboratories, formulated as per Standard Methods, 12th Edition, page 582.

Brilliant Green Bile Lactose Broth - Difco Laboratories, formulated as per Standard Methods, 12th Edition, page 584.

E. C. Medium - Difco Laboratories, formulated as per Standard Methods, 12th Edition, page 584.

PO_4 Buffered Water - pH 7.2, made in accordance with Standard Methods, 12th Edition, page 581.

4. Coliform Die-Off Study: Modification of the routine coliform determination to determine what changes occur in the coliform and fecal coliform populations in compost over time.

    a. Three 2.0 gram sub-samples were taken from a 50 gram sample of compost and suitable dilutions planted on lactose broth to determine the initial population. Five other 2.0 gram samples were dried for 24 hours at 100°C to determine the amount of moisture.

b. Two gram sub-samples were then taken at suitable times, diluted and planted in lactose broth.

c. Confirmation of total coliforms and fecal coliforms as well as calculation of MPN/gram dry weight were done as per the routine coliform determination.

5. Screening Method for Salmonella:

a. Place 5 weighed sub-samples (approx. 5 grams each) of the blended sample into 20 ml. of Tetrathionate broth and incubate at 37°C for 48 hours.

b. Streak Brilliant Green Agar plates with material from the tetrathionate tubes (two plates per tube). Incubate the plates for 24 hours at 37°C.

c. Transfer all lactose non-fermenting colonies (red) to TSI agar slants. (Stab and streak). Incubate slants for 24 hours at 37°C.

d. TSI slants showing alkaline slant (red) and acid butt (yellow) with or without H_2S are transferred to the following for biochemical testing:

1. Urea agar - incubate 24 hours at 37°C.
2. Simmons Citrate agar - incubate 24 hours at 37°C.
3. Phenylalanine agar - incubate 24 hours at 37° C.

e. Results of the biochemical differential tests are read at 24 hours. Cultures which do not produce a green color with the test reagent on phenylalanine agar, do not hydrolize urea and produce growth or do not produce growth on Simmons Citrate are selected for serological testing. Organisms producing phenylpyruvic acid (green test on phenylalanine agar0 and/or hydrolizing urea (red color in urea agar slants) are discarded.

f. Cultures which are possible Salmonella organisms are transferred to TSI and allowed to incubate for 18-24 hours at 37°C to obtain growth for serologic testing.

g. Suspensions of each culture are made with 0.85% NaCl solution and tested with Salmonella Polyvalent "O" antiserum. Those cultures showing no agglutination are classified as non-Salmonella. Those positive polyvalent "O" are tested for "O" groups A-1. This battery reportedly covers 96% of the known serotypes.

h. Those cultures showing positive for polyvalent "O" but not reacting with any of the specific antisera are tested for the Vi antigen. Those suspensions showing Vi antigen are placed in a boiling water-bath for 10 minutes to destroy the Vi, then retested for groups A-1. Cultures not reacting to Vi or groups A-1 but positive for polyvalent "0" are classified as non-Salmonella.

i. Cultures which are biochemically and serologically identifiable as Salmonella are sent to the Communicable Disease Center's regional Laboratory in Atlanta for confirmation.

j. Cultures carried through the biochemical testing which do not type as Salmonella are retested for the biochemical characteristics then if still showing Salmonella type biochemistry are serotyped and sent to the C.D.C. If the culture does not type as a Salmonella the second time it is discarded.

k. Media for Salmonella Screening:

  1. Tetrathionate Broth Base - Difco Laboratory formulation plus 1 ml. of Brilliant Green (1:10 000).

  2. Brilliant Green Agar - Difco Laboratory formulation plus 75 ml/l Sulfadiazine to inhibit spreading by Proteus.

  3. TSI - Triple Sugar Iron Agar, Difco Laboratories.

4. Phenylalanine Agar - Difco Laboratories. Test reagent for Phenylpyruvic and production sulfuric acid ferrous ammonium sulfate.

5. Simmons Citrate Agar - Difco Laboratories.

6. Urea Agar - Difco Laboratories.

7. Antisera - Polyvalent "O", Vi and groups A-1, Difco Laboratories.

6. Preliminary Bacteriological Results: Work thus far has been largely development of methods for determining the microbiological parameters desired by the State Board of Health, however, limited data on compost samples shipped from the Largo, Florida, pilot plant, the Houston, Texas, plant and the Gainesville plant are presented here. It is expected that much more baseline data will be obtained in the next quarter as up to this time the Gainesville plant has not been in full operation for any extended period of time and shipment of samples from Houston seems to alter the coliform population.

7. Compost Samples Shipped from Houston and Largo - September 10, 1967: Coliform determinations on samples which had been shipped and stored frozen from the Largo and Houston plants showed no coliforms in 7

of 9 samples and MPNs of only 4.3 and 2.9 per gram in the other two.

No tests for Salmonella were run as media was not available at the time the samples were run. These data are at variance with those obtained on fresh samples at the Gainesville plant and may be the result of die-off due to either heating during shipment or freezing.

8. Distribution of Microorganisms in Compost during Digestion at Houston, Texas: Samples of refuse collected at stages through the plant at Houston, Texas, were shipped to this lab and screened for total and fecal coliforms as well as Salmonella. Tables 4 and 5 show the results of these analyses. Five Salmonella like isolates were found in the sample of ground refuse and were sent to Atlanta for confirmation (this was prior to the arrival of Antisera to the Gainesville lab). These isolates were found to be Citrobacter, a group closely related to Salmonella but not considered pathogenic. No Salmonella like isolates were found in other samples in this test.

9. Commercially Available Soil Conditioners: Table 6 gives the results of coliform determinations on three soil conditioners offered for sale for agricultural

purposes. The milorganite (dried, pelletized sewage sludge) showed no coliforms probably as a result of heating when the sample was dried and pelletized. It is interesting to note that fecal coliforms could be found in both the dried cow manure and the composted cow manure.

10. Preliminary Data from Gainesville, Florida, Plant: The Gainesville plant has been running on a batch basis and much difficulty has been experienced in the mechanical operation of the plant. Therefore the results of coliform determinations and Salmonella screen are somewhat limited. All analyses were performed on finished products. Table 7 is a tabulation of the coliform and fecal coliform results thus far obtained. The $\log_{10}$ average MPN per gram dry weight for total coliforms was 1.18×10^6 with a wide range from 1.6×10^3 to 2.7×10^8. The MPN per gram dry weight of fecal coliforms was much lower, 2.5×10^2 - 4.5×10^5. Additionally, only 47.5% (ten of twenty-one) analyses showed fecal coliforms.

Twenty-seven sub-samples representing seven composite samples showed no organisms of the Salmonella group. Of the 58 colonies picked from the brilliant green agar over this period, only 15 showed the acid butt-alkaline slant reaction Nine of these positives

TABLE 4

DISTRIBUTION OF COLIFORMS IN COMPOST DURING DIGESTION AT HOUSTON, TEXAS

Source of Sample	Presumptive MPN/gm	Confirmed MPN/gm	Fecal Coliforms MPN/gm	Dry Wt. (gm)	% Moisture	Temp. °F
Ground Garbage Without Water	>1609	13	4.6	1.3	28	-
	>1609	13	---	1.0		
	>1609	19	---	0.9		
Ground Garbage With Water	88 x 100	88 x 100	None in	0.8	59	-
	195 x 100	195 x 100	Dilutions	0.9		
	240 x 100	240 x 100	Tested	0.7		
One Day Composting	>1609	60	0	0.8	55	122
	>1609	58	---	1.2		
	>1609	0	---	0.9		
Two Day Composting	>1609	0	0	1.2	50	130
	>1609	0	---	1.4		
	>1609	0	---	0.9		
Three Day Composting	>1609	0	0	1.2	50	154
	>1609	0	---	1.4		
	>1609	0	---	0.9		
Four Day Composting	No Gas	-	-	1.5	45	168
				1.6		
				1.0		
Five Day Composting.	No Gas	-	-	1.0	45	170
				0.9		
				1.3		
After Complete Digestion	No Gas	-	-	1.0	45	170
				1.2		
				1.3		
After Final Grinding	No Gas	-	-	1.4	48	-
				0.9		
				1.1		
Thirty Day Old Compost With Water	No Gas	-	-	1.2	46	-
				2.0		
				1.8		

TABLE 5

SALMONELLA PRESUMPTIVES IN HOUSTON GROUND GARBAGE

Sample Number	TSI (Butt Slant)	Phenylalamine	Citrate	UREA
1	Acid-Alkaline	-	+	-
2	Acid-Alkaline	-	+	-
3	Acid-Alkaline	-	+	-
4	Acid-Alkaline	-	+	-
5	Acid-Alkaline	-	+	-

TABLE 6

COLIFORM DATA ON SOIL CONDITIONERS

Dried Cow Manure

Sample	Dry Weight	Confirmed MPN/gram	Fecal Coliform MPN/gram
1	0.8491	0	0
2	0.8013	6.2	3.5
3	0.9367	5.3	0
4	0.9140	7.7	1.9

Milorganite

Sample	Dry Weight	Confirmed MPN/gram	Fecal Coliform MPN/gram
1	0.3183	0	0
2	0.6353	0	0
3	6.9431	0	0

Composted Cow Manure

Sample	Dry Weight	Confirmed MPN/gram	Fecal Coliform MPN/gram
1	0.3821	6.7×10^4	6.7×10^3
2	1.3408	1.1×10^4	5×10^2
3	0.9471	1.9×10^5	1.0×10^4
4	0.8392	1.5×10^5	5.5×10^3

TABLE 7

COLIFORM AND FECAL COLIFORMS FOUND IN COMPOST FROM GAINESVILLE, FLORIDA, PLANT

Date	Dry Weight	Confirmed MPN/gm.	Fecal MPN/gm.
3-20-68	2.30	5.60×10^4	1.90×10^3
	2.00	1.75×10^5	0
3-26-68	2.13	1.20×10^5	1.10×10^4
	2.05	4.5×10^4	1.10×10^4
	2.18	1.75×10^4	1.75×10^4
4-5-68	2.32	1.75×10^7	6.50×10^4
	2.00	1.65×10^8	4.5×10^5
	1.95	2.71×10^8	4.5×10^5
4-8-68	1.83	1.20×10^7	0
	2.41	3.5×10^6	6.0×10^4
	2.05	4.6×10^4	0
	2.56	1.6×10^3	2.5×10^2
4-11-68	2.00	1.75×10^7	0
	1.87	1.20×10^7	4.5×10^3
	1.98	1.20×10^7	0
4-15-68	2.13	3.5×10^4	0
	2.05	1.75×10^5	0
	2.01	5.40×10^5	0
4-16-68	1.80	1.75×10^8	0
	1.89	1.75×10^8	0
	1.93	5.5×10^5	0

hydrolized urea and were classified as "Proteus" and two were presumptive Salmonella; however, the latter were negative for polyvalent 0 antisera on three separate tests. It is interesting to note that 4 of the cultures produced a blue-green fluorescent pigment on phenylalanine agar. An aromatic grape-like odor was associated with these cultures and likely they are *Ps. aeruginosa*.

11. Die Off Study: Three coliform die off experiments have been completed at this time. The first study was done using finished compost from the Gainesville plant seeded with a broth suspension of *E. coli*. The other two consisted of withdrawing sub-samples from a 150 gram sample of compost at various times for 48 to 96 hours in the two runs. Not enough data is yet available to make quantitative statements. However, it appears that coliform populations, both fecal and non-fecal types, fluctuate over time and do not significantly die-off within 48 hours. Fecal coliforms appeared to decrease somewhat after 72 hours in the third test run. These preliminary data suggest that *E. coli*. and the coliform group may not serve as the best indicator of sanitary quality of compost and furthermore, consideration should be given to some other organism to serve this purpose. We are planning to examine compost for entercocci and, if possible,

determine die-off of this microorganism.

12. Mycology: A mycological study is being done under the auspices of the solid waste training grant number ITI SW 04-01. Some studies have indicated that the thermophilic funci are important or necessary to establish thermogenesis in compost. There is also evidence to indicate that they may play a role in reduction of pathogen survival times. Further work is needed to be made to determine the potential pathogenicity of these fungi themselves.

This investigation consists of sampling various stages of the thermogenesis of compost processed by the Metro Waste system in the demonstration plant in Gainesville to determine the population succession of Fungi. The initial investigation is being limited to funci that grow at 45°C or higher. In so far as possible, identifications and subcultures are being made of the isolates. Some preliminary work on the nutrition and physiology of these organisms is being attempted.

At the present time, of the trial samples that have been collected, four isolates have been successfully subcultured at 50°C. Further tests of their temperature range are being performed.

C. Arthropod and Rodent Control Program: Rat poisons fall into two categories, namely the single-dose and the multiple-dose poisons.

The success obtained by single-dose poisons, such as red squill, arsenic, and ANTU, depends upon the consumption of a lethal amount of poison at one meal. These poisons give quick kill but are dangerous because of this high mammalian toxicity.

Multiple-dose poisons are usually effective only after several feedings. Anti-coagulants, such as Warfarin, Pival, Fumarin, and Diphacin, are multiple-dose poisons which prevent the normal clotting of blood and cause rats and mice to die by internal bleeding. These poisons are relatively safe to mammals since multiple feeding is required and the dosage requirement is high.

1. Baits: Anti-coagulants, when mixed with food in the recommended proportions, are odorless and tasteless to rats. Therefore, doses expressed on the package should be adhered to.

   A bait should be relatively non-perishable and unattractive to man and domestic animals. Corn meal and rolled oats fall close to these requirements. An all-purpose bait may contain the following: corn meal - 65%, rolled oats - 20%, powdered sugar - 5%, vegetable oil - 5%, and anti-coagulant - 5%. The bait used at the Gainesville Compost Plant is as follows: corn meal - 8#, rolled oats - 3#, powdered sugar - 1/2#, and Pival - 1#.

These baits can be mixed and stored in a barrel, drum, or plastic garbage can. They should be marked 'poison' and stored under lock and key.

Baits can be distributed in paper trays which are placed in bait stations.

a. Bait Stations: Poisons should be placed under protective cover to reduce the hazards of accidental poisonings. Bait stations provide cover preferred by rats, protect the bait from dust and weather, and reduce the danger to humans and domestic animals.

   Bait stations should be constructed of solid materials to avoid breakage. They should be rectangular boxes with open bottoms since rats will enter more willingly on surfaces to which they are accustomed. Openings at each end of the station should be 3" high by 2 and 1/2" wide. The station should be at least 10" high so either liquid or dry baits can be used.

This type of station is recommended for the compost plant because of the dust which soon renders uncovered baits inefficient.

b. Location of Bait Stations: Effective rodent control is dependent on proper placement of bait stations. Since rats often follow a path which keeps them in contact with a vertical wall, bait stations should be placed so that one edge is touching a wall.

A bait station located in the path of the rodent is most likely to be effective. When placing bait stations the operator should look for evidence such as gnawing, droppings, or greasy trails left by many rats. If there is no observable evidence of rodents the bait stations may be located in dark protected areas. In open buildings, as the compost plant, bait stations should be placed along the walk or other suitable sites in areas near doors or openings where rodents may enter from outside the building.

c. Liquid Baits: Liquid baits are effective under dry conditions or in areas where available water is low. Liquid baits are available in small packets sufficient for one quart of water. The poison is placed in Mason quart jars which are filled with water and fitted with a water tray like those used for chickens. The liquid bait is then placed in bait stations. Liquid and dry bait can be placed in the same station for very effective results.

2. Roaches: An insecticide should be selected which is effective on most species of roaches. A one percent solution of Diazinon may be used in most cases since there has not been any wide spread resistance reported on this insecticide. This solution may be applied by a one gallon compressed air sprayer. A fine mist swath about 18 inches wide should be applied along the lower portion of most vertical walls. Care should be taken as not to spray electrical connections and apparatus. However, the warmth of electrical equipment affords a good hiding place for roaches and the cabinets should be sprayed being careful not to spray mechanisms.

   The shower and rest rooms should be sprayed thoroughly. Lockers should be sprayed since they often contain scraps from lunches.

   Drains should be sprayed. These offer shelter and water to roaches.

   The receiving area in compost plants should be thoroughly sprayed since roaches may enter with garbage.

The wooden retaining wall in this area presents many cracks which may provide harborage for these insects.

The office building should be sprayed. Spot spraying of baseboards along the walls and inside closets and the rest room is necessary for protective maintenance. This insecticide is also effective on ants and other crawling insects in the building.

Spraying should be carried out once each month. If a high infestation is noted, spraying every two weeks and changing insecticides may be necessary to reduce the population.

If the area is dusty then spraying should be accomplished after the plant is cleaned for the day or in the morning before operation begins.

Five percent chlorodane granules should be spread in a ten foot swath around the perimeter of the buildings bordered by soil. This will kill roaches and crawling insects trying to enter the building. The granules may be sowed by hand (gloves should be worn) or rubber bulbs. Granules should be distributed monthly.

3. Traps: Baited roach traps are effective in trapping a sample of the population to determine species present and are of some use to help determine population size. Traps baited with stale beer can be used

to trap most species.

The dust of compost plants renders traps ineffective unless they are placed in a dust free area or hooded to keep out the dust.

4. Flies: Compost plants do not appear to support breeding of houseflies. The length of time in the digester is not sufficient to provide for the emergence of an adult fly. If the building is kept clean, breeding should not occur.

   Adult flies are present and may reach nuisance levels. These flies may be carried in with the garbage or may be drawn from the adjacent areas.

   Control of these flies may be accomplished by sugar baits on the flat unused surfaces in the receiving area, picking area, and digesting tanks. One effective bait is Dipterex which can be used to reduce adults.

D. Occupational Health Program: Dr. George Little of Gainesville, Florida, has given physical examinations to workers in the compost facility. On his recommendation, all workers will be interviewed at a six-month interval following the initial physical examination to determine on an informal basis their health status.

A noise survey was conducted at the Gainesville Compost Plant while in operation April 26. Noise levels were determined at various points within the plant to assess the risk of auditory damage.

The following table will show the general noise levels in decibels. The survey showed that the sound levels in the location of the picking platform behind the primary grinder were above the safe limits as outlined in the Industrial Noise Manual published by the American Industrial Hygiene Association. Our determinations show that workers in this area should be fitted with approved ear plugs to protect them from a hearing loss.

To date, sixteen complete physical examinations have been given. Four employees have not been examined because of failure to keep scheduled appointments. All of the employees are males ranging from 18 to 51 years of age with an average age of 31 years. There is no evidence of any physical abnormalities except in two employees, who have a conductive hearing loss.

Fairly complete blood examinations have been made including hematocrit (cell mass/blood volume) and hemoglobin. VDRL tests were also run on all workers. The results of the blood examinations were normal and no positive VDRL's were obtained.

Urine samples were examined for pH, specific gravity, glucose, The scales A, B, and C indicate the relative frequency of the sound. The C scale indicates total response and the reading on the A and B scales indicates that higher frequencies are prevalent. Therefore, the higher the reading on the A and B scales relative to the total response on the C scale indicates higher frequencies and therefore, a higher risk to the workers who are exposed to that area.

TABLE 8

NOISE LEVELS WITHIN THE GAINESVILLE PLANT

Location	Level (dB)	Noise Band (frequency)
Picking platform		
Middle station	94-96	A, B, C
Station nearest grinder	100-102	B, C
Average	96	A
Ground level at control station grinder	102	C
Primary grinder	100	C
Average	96	A
Digesting bins, start of conveyor belt	96	C
	81	B
	87	A
Outside grinder door	86	C
	81	B
	76	A
Ambient noise levels		
Picking platform	79	C
Digesting conveyor	70	C
Outside without blower	64	C

acetone, occult blood and protein. The results of all these tests were normal.

All patients were given containers to collect and submit stool samples for examination. To date only five of sixteen have completed this phase of the medical examination. These stool samples are checked for hookworm, Ascaris, and tapeworms. All submitted have been negative, however, one patient has a Giardia infection.

There have been four accidents which have required the attention of a physician. All of these were minor falls or bruises sustained from an object dropped on a worker's foot.

Chest X-rays have yet to be completed on employees. This examination will be done with the cooperation of the County Health Department and will be scheduled soon. Subsequent to the Johnson City conference, we are also including Mantoux and Histoplasmin skin tests.

-VI- LIST OF VISITORS TO GAINESVILLE COMPOST PLANT

January 1, 1968 through April 30, 1968

NAME	WHERE FROM	REPRESENTING
J. V. Boland	St. Louis, Mo.	Americana
Earl Jacob	St Petersburg, Fla.	Int. Disposal Corp.
Roger A. Lynn	St. Petersburg, Fla.	Int. Disposal Corp.
J. S. Duggan	Sevierville, Tenn.	T. V. A.
J. R. Hathcote	Muscle Shoals, Ala.	T. V. A.
J. H. Walker	Marion, Ohio	Fairfield Engineering
R. N. Shreve	St. Paul, Minn.	Conwed Corporation
T. C. Edgren	Atlanta, Ga.	Conwed Corporation
E. Martin	Gainesville, Florida	Santa Fe Jr. College
Edwin B. Turlington	Gainesville, Florida	City of Gainesville
James S. Coulson	Marion, Ohio	Fairfield Engineering
Victor Peterson	Buffalo, N. Y.	City of Buffalo
Victor Peterson, Jr.	Buffalo, N. Y.	City of Buffalo
Clarence Powney	Dunnellon, Florida	
Robb Tyler	Baltimore, Maryland	
Eleanor R. Brown	Toledo, Ohio	
Roger A. Lynn	St. Petersburg, Fla.	Int. Disposal Corp.
Art Mohler	St. Petersburg, Fla.	" " "
C. W. Lear	Tampa, Florida	" " "
John F. Staus	Shiboygan, Wisconsin	
Jean Chance	Gainesville, Florida	G'ville League of Women Voters
Charles W. Fristoe	Gainesville, Florida	" " "
Lucille Fristoe	Gainesville, Florida	" " "

NAME	WHERE FROM	REPRESENTING
Sidney Martin	Hawthorne, Florida	County Commissioner
Mrs. Ralph Kleege	Gainesville, Florida	G'ville League of Women Voters
Mrs. John K. Mahon	Gainesville, Florida	" "
Mrs. Herbert A. Sawyer	Gainesville, Florida	" "
Mrs. F. K. Hardy	Gainesville, Florida	" "
Mrs R. H. Hiess	Gainesville, Florida	" "
Mrs. N. Z Ohin	Gainesville, Florida	" "
Mrs. Hunt Davis, Jr.	Gainesville, Florida	" "
Mrs. Art Burns	Gainesville, Florida	" "
Mrs. E. Lowe Pierce	Gainesville, Florida	" "
Ernestine Benninger	Gainesville, Florida	" "
Mrs P. R. McIntosh	Gainesville, Florida	" "
Mrs. D. B. Ward	Gainesville, Florida	" "
Mrs. R. E. Bradley	Gainesville, Florida	" "
Linda Sanders	Gainesville, Florida	" "
Lila Hammer	Gainesville, Florida	" "
Helen Hayes	Gainesville, Florida	" "
George M. King	Marion, Ohio	Fairfield Engineerir
Don Barry	Pontiac, Michigan	Oakland County
Daryl Schuler	Pontiac, Michigan	Oakland County
James K. Nichols	Pontiac, Michigan	Oakland County
W. W. Liberick	Atlanta, Ga.	U. S. P. H. S.
T. Sorg	Cincinnati, Ohio	U. S. P. H. S.

NAME	WHERE FROM	REPRESENTING
M. DeVon Bogue	Atlanta, Ga.	U.S.P.H.S.
E. G. Byrne	Gainesville, Florida	Health Dept.
M G. LaPorte	Baltimore. Md.	The Heil Co.
Arnold F. Meyer	Milwaukee, Wis.	The Heil Co.
John Reinhardt	Madison, Wisconsin	City of Madison
R W. Steinhofer	Madison, Wisconsin	City of Madison
Warren Porter	Madison, Wisconsin	University of Wis.
Fred T. Anderson	St. Petersburg, Fla.	Glace Engineering Corp
C. A. Ron	Gainesville, Florida	Alachua County Health Dept.
P. J. Wolfert	Pompano Beach, Florida	Fairfield Engineering
Thompson Van Hyning	East Lake Weir, Fla.	
Edward C. Schueler	Poughkeepsie, N. Y.	Town of Pough, N.Y.
Sam Amodeo	Poughkeepsie, N.Y.	City of Poughkeepsie
Theo W. Maurer	Poughkeepsie, N.Y.	City of Poughkeepsie
Frank J. Gaigrul	Gainesville, Florida	University of Florida
Al Jones	Gainesville, Florida	
J. N. Haley, Jr.	Williston, Florida	
Glen Larsen	Washington, D. C.	Southern Railway Co.
Robert N. Morris	Washington, D. C.	Southern Railway Co.
F. Ottenheimer	Pittsburgh, Pa.	Westinghouse R & D
Frank Rigo	Largo, Florida	Int. Disposal Corp.
C. W. Lear	Tampa, Florida	Westingthouse
Paul Willis	St. Petersburg, Fla.	Int. Disposal Corp.
Art Mohler	St. Petersburg, Fla.	Int. Disposal Corp.

NAME	WHERE FROM	REPRESENTING
Ralph L. Tabor	Washington, D. C.	Nat'l Association of Counties
Linton Floyd	Gainesville, Florida	Boy Scouts
R. P. Vogh	Gainesville. Florida	Sewage Disposal
S. M. Richard, Jr.	Sanford, Florida	Utility Dept.
W. P. Allman	Orlando, Florida	Waste Water Dept.
Wm. B. Adams	Eustis, Florida	Waste Water Treatment
B. B. Simon	Orlando, Florida	B & H Sales
Barney Kane	Gainesville, Florida	Environmental Eng.
R. W. Starr, Jr.	Ft. Pierce, Florida	S. E. Region, Fla. St. Board of Health
Bud Calhoun	Hollywood, Florida	City of Hollywood
Wm. Menoher	Ft. Pierce, Florida	Fla. St. Board Health
Palmer H. Craig, Jr.	Gainesville, Florida	Conservation Week
Mrs. F. W. Conner	Gainesville, Florida	Conservation Week
Mr. W. B. Person	Gainesville, Florida	Conservation Week
Mrs. Robert L. Fairing	Gainesville, Florida	Gainesville Womens' Club
M. H. Wing	Gainesville, Florida	Conservation Week
Mrs. P. H. Craig, Jr.	Gainesville, Florida	Conservation Week
Otto Voelchner	Gainesville, Florida	
William C. Harper	St. Clair Shores, Mich.	South Macomb Disposal Authority
Glen Alsip	" " " "	" " "
Stephen Okros	" " " "	" " "
C. C. Hahn	Orlando, Florida	Orange County Arthropod Control.

NAME	WHERE FROM	REPRESENTING
Thomas Furman	Gainesville, Florida	University of Florida
Dalin Ensliger	Gainesville, Florida	University of Florida
Arseuro Milian	Gainesville, Florida	
Kui-Chun Tsai	Gainesville, Florida	
George R. Grantham	Gainesville, Florida	
John E. Ball	McIntosh, Florida	
Cofaro Dennis	Gainesville, Florida	University of Florida
H. R. Madvey	Freeport, Bahamas	Sanitation Services Co
Dan Zbin	Ft. Lauderdale	Zbin Landscaping Co.
E. S. Butler, Jr.	Freeport, Bahamas	Sanitation Services Co
Glen D. Larson	Washington, D. C.	Southern Railway
James J. Duorak	Ft. Lauderdale	DeLeuw, Cather & Co.
L. Lechner	Chicago, Illinois	DeLeuw, Cather & Co.
M. Tyson	Cordele, Ga.	Harris Press & Shear
C. A. Prince, Jr.	St. Petersburg, Florida	Sinclair Ref. Co.
K. R. Quillen	Gainesville, Florida	Sinclair Ref. Co.
John D. Baldwin	Gainesville, Florida	United Fuels Corp.
Wm. E. Benn	Vernon, N. J.	Waste Conversion Co.
Paul Lead	Miami, Florida	Dade County
John V. McCue	Miami Florida	Dade County
John W. Greenleaf, Jr.	Miami, Florida	Greenleaf/Telesca
B. Reilly	Pittsburgh, Pa.	

NAME	WHERE FROM	REPRESENTING
Roman Des Lasier	Dade City, Florida	Withlacoochee River Elect.
T. C. Kelly	Key West, Florida	City Electric System
John W. Greenleaf, Jr.	Miami, Florida	
Roger A. Lynn	St. Petersburg, Fla.	International Disposa Corp.
H. E. Strauser	Bayard, Florida	
D D. Strauser	Gainesville, Florida	
C. G. Easterday	Jacksonville, Florida	Ward Engineering Co.

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APPENDIX A

Florida State Board of Health

WILSON T. SOWDER, M.D., M.P.H., STATE HEALTH OFFICER
MALCOLM J. FORD, M.D., M.P.H., DEPUTY STATE HEALTH OFFICER

JACKSONVILLE, 32201

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POST OFFICE
BOX 210

REAU OF SANITARY ENGINEERING
DNEY A. BERKOWITZ, P.E., M.S. IN ENG.
DIRECTOR

DIVISION OF WATER SUPPLY
J. B. MILLER, P.E., M.P.H.
DIRECTOR

DIVISION OF SPECIAL SERVICES

DIVISION OF WASTE WATER
RALPH H. BAKER, JR., P.E., M.S.S.E.
DIRECTOR

DIVISION OF INDUSTRIAL WASTE
NICK MASTRO, P.E., M.P.H.
ACTING DIRECTOR

March 22, 1968

IN REPLY PLEASE REFER TO

Alachua County G&R
Gainesville Municipal Waste
Conversion Authority /116

Doctor C. I. Harding
Environmental Engineering, Inc.
2324 S.W. 34th Street
Gainesville, Florida 32601

Dear Doctor Harding:

This will acknowledge receipt of engineering plans and other applicable documents for an incinerator to serve the Gainesville Municipal Waste Conversion Authority Plant located at S.E. 14th Avenue, Gainesville, Alachua County, Florida.

These documents have been reviewed and approved under our Serial No. INC-424 dated March 22, 1968, subject to the following provisos:

1. Construction on this project must be commenced within 120 days from the date of this application; otherwise, plans and specifications must be resubmitted for approval by this department.

2. This approval is given with the understanding that upon the installation of such works, its operation shall be placed under the care of a competent person whose qualifications are approved by the State Board of Health and the operation shall be carried out according to best accepted practice and in accordance with the recommendations of the State Board of Health.

3. By copy of this letter to the owner, we are advising that approval is given functional aspects of this project on the basis of representations to and data furnished this department; and there may be county, municipal or other local regulations or restrictions to be complied with by the owner prior to construction of the facilities represented by the referred to plans; and we, therefore, recommend that appropriate local agencies be consulted before starting construction.

4. The engineer of record in this application shall be responsible for supervision of the construction of this project and upon completion shall inspect for complete conformity to the plans

and specifications as approved. A report of such inspection in writing and signed by the engineer shall be rendered to the Alachua County Health Department and to the Florida State Board of Health, Bureau of Sanitary Engineering, P. O. Box 210, Jacksonville, Florida.

5. The Florida State Board of Health shall be notified of any changes or revisions made during construction.

6. Any time this unit is found to be performing inadequately because of overloading, neglect, or other reasons, the owner shall discontinue its use until measures are provided to correct the cause of such performance.

7. This unit shall be used only for burning Type I waste, such as rubbish consisting of wood scraps, paper and rags.

8. The incinerator shall not be loaded in excess of its capacity of 7500 pounds per hour.

9. After this installation has been in operation for a period of six months, a plant operation report as required by the Rules and Regulations of the Florida Air Pollution Commission shall be submitted to this Agency.

10. Satisfactory ladders, platforms, and other safety devices shall be provided as well as necessary ports to facilitate the carrying out of an adequate sampling program.

11. The incinerator shall have a metal name plate affixed in a conspicuous place on the incinerator shell showing manufacturer, model number, type waste, rated capacity and approval number.

Distribution of the approved documents will be made within the next few days.

Very truly yours,

N. Mastro

Nick Mastro, P.E.

NM:WEL:srk
CC: Alachua County Health Dept.
CC: Mr. Larry P. Robinson
CC: Gainesville Municipal Waste Conversion Authority
CC: Board of County Commissioners

APPENDIX B

Processing and Salvage Chart - January

BLOCK A - PROCESSING

Batch No. ____	TODAY	TOTAL THIS MONTH	11 DAY AVERAGE
No. of Trucks Received: City 44			
County			
Univer.			
TOTAL		44	4
Tons of Refuse Received: City 134			
County			
Univer.			
TOTAL		134	12.2
Hours Primary Grinder Ran		29.5	2.7
Hours Secondary Grinder Ran		29.5	2.7
Tons per Hour Ground		4.5	
Gallons of Sludge Added			
Paper Bales - NEWS			
Paper Bales - CORRUGATED			
Paper Bales - MIXED 750# per bale		36	3.3
Rag Bales		2	
Tons of Steel Scrap			
Tons of Tin Cans		4.7	.4
Tons of Non-Compostables		9	.8

BLOCK B - FINISHING

Batch No. ____	TODAY	THIS MONTH	___DAY AVERAGE
Hours Regrinders Ran			
Tons of Bulk Compost			

SALVAGE TABLE

ITEM	TONNAGE	PERCENTAGE	VALUE
Paper	13.5	10.0	$202 50
Tin Cans	4.7	3.5	
Scrap Iron	0.0	0.	
Non-Compostables	9.0	6.7	
Compostables	106.8	79.8	
TOTALS	134.	100.	$202.50

GENERAL NOTES:

Tin cans are being hauled out to landfill at present until we can establish a market.

Paper is bringing $15.00 per ton at present.

APPENDIX B

Processing and Salvage Chart - February

BLOCK A - PROCESSING

Batch No. ______	TODAY	TOTAL THIS MONTH	7 DAY AVERAGE
No. of Trucks Received: City 86			
County			
Univer.			
TOTAL		86	12.2
Tons of Refuse Received: City 277.9			
County			
Univer.			
TOTAL		277.9	39.7
Hours Primary Grinder Ran		37	5.2
Hours Secondary Grinder Ran		37	5.2
Tons per Hour Ground		7.5	
Gallons of Sludge Added			
Paper Bales - NEWS			
Paper Bales - CORRUGATED			
Paper Bales - MIXED cw. 750# per Bale.		39	5.5
Rag Bales			
Tons of Steel Scrap			
Tons of Tin Cans		4.1	.59
Tons of Non-Compostables		10.5	1.5

BLOCK B - FINISHING

Batch No. ______	TODAY	THIS MONTH	___DAY AVERAGE
Hours Regrinders Ran			
Tons of Bulk Compost			

SALVAGE TABLE

ITEM	TONNAGE	PERCENTAGE	VALUE
Paper	19.6	7.0	294.00
Tin Cans	4.1	1.4	
Scrap Iron	0.0	0.0	
Non-Compostables	10.5	3.7	
Compostables	243.7	87.9	
TOTALS	277.9	100.0	$294 00

GENERAL NOTES:

APPENDIX B

Processing and Salvage Chart - March

BLOCK A - PROCESSING

Batch No. ____________	TODAY	TOTAL THIS MONTH	11 DAY AVERAGE
No. of Trucks Received: City 134			
County			
Univer.			
TOTAL		134	12.1
Tons of Refuse Received: City 461.1			
County			
Univer.			
TOTAL		461.1	41.9
Hours Primary Grinder Ran		46.3	4.2
Hours Secondary Grinder Ran		46.3	4.2
Tons per Hour Ground		10	
Gallons of Sludge Added			
Paper Bales - NEWS			
Paper Bales - CORRUGATED			
Paper Bales - MIXED 750# per bale		38	3.5
Rag Bales			
Tons of Steel Scrap			
Tons of Tin Cans			
Tons of Non-Compostables		45.6	4.1

BLOCK B - FINISHING

Batch No. ____________	TODAY	THIS MONTH	11 DAY AVERAGE
Hours Regrinders Ran		80.5	7.3
Tons of Bulk Compost		550	50

SALVAGE TABLE

ITEM	TONNAGE	PERCENTAGE	VALUE
Paper	14.3	3.1	214.50
Tin Cans			
Scrap Iron	45.6	9.8	
Non-Compostables			
Compostables	401.2	87.1	
TOTALS	461.1	100.0	214.50

GENERAL NOTES:

APPENDIX B

Processing and Salvage Chart - April

BLOCK A - PROCESSING

Batch No. ______	TODAY	TOTAL THIS MONTH	15 DAY AVERAGE
o. of Trucks Received: City 304			
County 39			
Univer. -			
TOTAL		343	22.8
Tons of Refuse Received: City 892.6			
County 81.5			
Univer.			
TOTAL		974.1	64.9
Hours Primary Grinder Ran		76.4	5.1
Hours Secondary Grinder Ran		76.4	5.1
Tons per Hour Ground		12.8	
Gallons of Sludge Added			
Paper Bales - NEWS			
Paper Bales - CORRUGATED			
Paper Bales - MIXED 750# per bale		103	6.9
Rag Bales			
Tons of Steel Scrap			
Tons of Tin Cans		53	3.5
Tons of Non-Compostables		87.2	5.8

BLOCK B - FINISHING

Batch No. ______	TODAY	THIS MONTH	15 DAY AVERAGE
Hours Regrinders Ran		108 5	7.2
Tons of Bulk Compost		566.5	31.1

SALVAGE TABLE

ITEM	TONNAGE	PERCENTAGE	VALUE
Paper	38.6	4.0	$579.00
Tin Cans	53.0	5.4	------
Scrap Iron	0	0	------
Non-Compostables	87.2	8.9	------
Compostables	795.3	81.7	------
TOTALS	974.1	100.0	$579.00

GENERAL NOTES:

APPENDIX C

MODEL CDM-4830-HD

METRO WASTE INSTALLATION - Gainesville, Florida

Subject: Installation of Screw Conveyor Discharge.

Instructions - Reference drawing ESK-1165 Sheets 1 thru 3

1. Remove 1/4 thick plate under lower track of disintegrator, sheet 1, zone E-6.
2. Remove lower track drive from underside of disintegrator. Do not remove structural members on machine to which the drive mounts. Sheet 1, zone D-6.
3. Relocate lower track drive to support structure. Sheet 1, zone D-6, adding necessary structural members as shown in section (S-1/2).
4. Remove hydraulic overload package from present location above motor; sheet 1, zone D-4. (To clear for conveyor).
5. Relocate hydraulic package to frame at level of 300 H.P. motor; sheet 1, zone C-6.
6. Add 6 WF @ 25# members as shown in Section (S-1/1). Sheet 1, zone C-9.
7. Relocate cross beam in support structure at discharge end of disintegrator, sheet 1, zone C-3.
8. Fabricate and install fabricated beam shown in section (S-3/1) as taken in section (S-2/1). (Stiffen for new rotor).
9. Box in 6 WF^s with plate, as shown on sheet 2, zone D-5. (Eliminates "pockets").
10. Install 1/8" thick baffle plates as shown in section (S-2/1) zones F-9 & F-6.
11. Install 3x3x1/2 angles for mounting conveyor trough. Locate angles per dimensions: 18" sheet 3, zone E-7, & 84" sheet 2, zone D-5. Weld angles to beam ref. instruction 8.
12. Install 3x3x1/2 cross angle, ref. sheet 3, zone B-2.

APPENDIX C, Continuation:

Weld to 6 WF supports (Instruction #6) & 3x3x1/2 angle (Instruction #11).

13. Install conveyor and baffle plate support angles (3x3x1/4) sheets 2 and 3.

14. Install bolt in baffle plates (6), three on each side, ref: sheet 3.

15. Weld in feed end baffle plates ref. sheet 2, zone D-7.

16. Alter ballistic chamber to slinger for insertion of screw conveyor.

17. Install screw conveyor.

APPENDIX D

MODEL CDM-4830-4830-HD

METRO WASTE INSTALLATION - Gainesville, Florida

Subject: Installation of Flying Hammer Assembly

Instruction: Reference Drawing ESK-1167 - Sheets 1 thru 2 and CSK-1167 - Sheet 3

1. Release hydraulic pressure, remove pivot pins thru hydraulic cylinders and lift overload. (Top Frame).
2. Remove each bottom side plate segment from Hammer Shaft to discharge end of Disintegrator (1 each side), as shown on Sheet 2.
3. Remove each top side plate segment from star shaft to discharge end of Disintegrator (1 each side) as shown on Sheet 3.
4. Remove solid hammer shaft and star shaft assemblies, leaving bearings on shafts.
5. Remove each bottom side plate segment between hammer shaft and lower track shaft (1 each side), as shown on Sheet 2.
6. Remove each top side plate segment between star shaft and top track shaft (1 each side), as shown on Sheet 3.
7. Remove bottom pan track conveyor and lower track shaft in crushing zone of Disintegrator, leaving bearings on track shaft. Sheet 1, Zone D-6.
8. Remove each bottom track bearings support (1 each side). Sheet 1, Zone D-6.
9. Remove each 4" thick hammer bearing plates (1 each side). Sheet 1, Zone D-7.
10. Remove remaining 1/4" thick plate under hammer. Sheet 1, Zone D-7.
11. Cut ballistic chamber feed plate to bottom of 10WF. Sheet 1, Zone D-8.
12. Remove stub beams and plates that were used to support bottom side plate segments (Refer to instruction 25). Sheet 1, Zone D-9.

Appendix D, Continuation:

13. Remove 8 WF cross beam, bearing plates and gussets under hammer. Sheet 1, Zone D-7.

14. Weld in place 1/2" thick plate to seal off area under hammer. Sheet 1, Zone D-8.

15. Cut new and remaining top side plate segments as shown on Sheet 3, Zone B-2.

16. Remove each 2" high star bearing shim. (1 each side).

17. Install new top side plate segments. CSK-1157 Group "C" and CSK-1157, Group "D" (Refer to instruction 19). Sheet 3, Zone B-2. (See Note "D")

18. Install new star rotor assembly (3,680,364-1), mount bearings on 10 WF Beam of Disintegrator frame using same mounting holes. (See notes "B" & "D").

19. Install remaining new top side plate segments. CSK-1157, Group "A" and CSK-1157, Group "B". Sheet 3, Zone B-3. (See note "D").

20. Modify lower track support per CSK-1158.

21. Modify remaining bottom side plates (1 each side) per Sheet 2. (Refer to instruction 27).

22. Weld 1/2" thick gussets under hammer in place (8 each side of web, 12 total). Sheet 1, Zone D-3.

23. Drill 1 1/16" diameter holes thru 10 WF beam for mounting of hammer bearings. Sheet 1, Zone F-3. Burn Wrench holes as shown on Sheet 1; Zone D-3.

24. Weld lower track bearing brackets (CSK-1155, Group "A" and Group "B") in place. Sheet 1.

25. Weld bottom side plate mounting supports to inside flange of 10 WF for new side plate mounting. Position mounting supports with new bottom side plates in position to insure proper alignment of these side plates. (Refer to instructions 27 and 29). Remove side plates after mounting supports have been aligned. Sheet 2.

26. Install new 3/8" thick pan conveyor and bottom track shaft assembly. (Refer to Notes "A" and "D"). Sheet 1, Zone E-2.

APPENDIX D, Continuation

27. Install each new bottom side plate segment (1 each side) (CSK-1157, Group "G" and Group "H" (Refer to instruction 29) Sheet 2, Zone B-7.

28. Install new flying hammer rotor assembly (3,680,365-1). Place each 3/8" thick bearing shim (ASK-1156) under each hammer bearing. Mount bearings on new holes in 10 WF beam (see notes "C" and "D"). Refer to instruction 30. Sheet 1, Zone D-3.

29. Install each remaining new bottom side plate segment (1 each side) CSK-1157, Group "E" and Group "F" (see note "D"). Sheet 2, Zone B-8.

30. Position hammer, star and lower track shaft assemblies as noted: 18 1/2" approximate center of hammer shaft to center of star shaft; 25 1/4" center of hammer shaft to center of lower track shaft. Sheet 1, Zone E-3.

31. Weld bearing stop blocks in place. Sheet 1.

32. Check to insure that there is clearance between flying hammers and lower track, and between hammers and star shaft.

33. Install new sheave (BV. 22.4 D.D., 14 Groove) on hammer shaft.

NOTES:

A. Lower track bearing bolts - 7/8-9 x 5 1/2 long, Grade 5.

B. Star bearing bolts - 7/8-9 x 6 1/2 long, Grade 8.

C. Hammer bearing bolts - 1-8 x 6 long, Grade 8.

D. Coat all bearing bolts with Loctite "Screwlock".

Refer to "Typical Bearing Mounting" as shown on Sheet 1, Zone E-7.

APPENDIX E

May 3, 1968

From: Arno J. Liebman, Consultant
Centriblast Corporation
Pittsburgh, Pennsylvania

To: Mr. Herbert Houston
c/o Gainesville Municipal Waste Conversion Authority, Inc.
Gainesville, Florida

Subject: Centriblast Disintegrator Model CDM-4830 A.D.

Dear Herb:

During the past 2 1/2 weeks, I have visited your operations on a daily schedule, in order to modify certain parts of the subject disintegration station. These modifications were agreed upon by our Manager, Mr. Fred Josenhans and by the Metropolitan Waste President, Mr. Vic Brown and Vice President, Mr. I Anderson.

In general, the following work has been completed to date:

1. Modification of the frame and housing assembly for use with the new flying hammer and star feed rotor.

2. Installation of the new flying hammer rotor and star feed rotor.

3. The weld application of several hard facing materials, as specified by me, in order to develop an optimum service cycle for the hammers. Installation of hammers within rotor assembly.

4. The installation of metal plate deflectors below and behind the hammer rotor in order to minimize the spillage of disintegrated product.

5. The installation of an ampere recording instrument for purposes of charting the performance characteristics of the disintegrator with your specific products at rates ranging from 8 tons per hour to 20 tons per hour.

Personal Observation.

The work described above was carried out by your corporation under my supervision. I would like to compliment you and your staff for the fine cooperation given me at all times and the thoroughness with which all jobs were done on this project.

Additional Work Required.

During my visit with you, some of the work could not be completed. This includes mainly the installation of deflection shields inside of the disintegrator housing, to prevent the spillage of product and the up-blocking of the upper part of the machine with this product. Our chief engineer will submit additional detail prints for this minor modification. In addition, it will prove of mutual benefit if you would have your staff check on the progress of wear on the hammer tips. Please submit to us a copy of the results once per week. I have records of the performance to date, a copy of which will be submitted to you.

Again, thank you for your fine cooperation.

Sincerely yours,

Arno J Liebman

Arno J. Liebman
Consultant for Joy Manufacturing Company.

AJL:jb

cc: Mr. Fred Josenhans, General Manager, Centriblast Corp.
cc: Mr. Victor Brown, President, Metropolitan Waste Conv. Corp.
cc: Arno J. Liebman

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INTERIM REPORT

May, 1968 - August, 1968

GAINESVILLE MUNICIPAL WASTE CONVERSION

AUTHORITY, INC.

Re: DEMONSTRATION GRANT NO. 5-D01-UI-0030-03

GAINESVILLE COMPOST PLANT

Submitted to

U. S. PUBLIC HEALTH SERVICE
SOLID WASTES PROGRAM
DEPARTMENT OF HEALTH, EDUCATION & WELFARE

Metro Waste Composting Systems

GAINESVILLE MUNICIPAL WASTE
CONVERSION AUTHORITY, INC. • P.O. BOX 1152 • GAINESVILLE, FLORIDA 32601 • 904 • 372-4275

December 27, 1968

Mr. John Ruf, Project Officer
Demonstration Grants Activities
Solid Wastes Program
C/O Gainesville Municipal Waste
Conversion Authority, Inc.
Postoffice Box 1152
Gainesville, Florida 32601

Re: Demonstration Grant
#5-D01-UI-0030-03

Dear Mr. Ruf:

We are herewith submitting the second Interim Report on the above mentioned Demonstration Grant, covering the period of May through August, 1968.

During this period, we attempted to get into full operation as distinguished from our shake-down period the first four months. This was pretty well accomplished except for a few mechanical problems, one of which was major. An evaluation of each piece of equipment is made in the pages that follow.

An attempt is made to establish some operational costs on the major components of the plant, however, part of the period cannot be considered typical, due to some of the mechanical problems.

The laboratory work has proceeded at a much more satisfactory pace under the direction of Dr. David Knuth of Environmental Engineering, Inc. His Technical Evaluation is covered under Section VI of this report.

In spite of difficulties, we feel that definite progress was made during this period of demonstration; and that still further progress will be obtained during the balance of this year.

Sincerely,

H.W. Houston

H. W. Houston,
Porject Director

CABLE ADDRESS • METROWASTE

HWH/nr

INTERIM REPORT

May, 1968 - August, 1968

TABLE OF CONTENTS

ITEM PAGE

-I- GENERAL PROGRESS 1

A. OPERATIONS 1

1. Problems 2
2. Changes 4

B. ODOR COMPLAINTS

1. Reasons 5
2. Solutions 5

C. PERSONNEL 7

1. Shifts and Wages 7
2. Injuries 11

D. MARKETING 11

-II- AMOUNT OF REFUSE PROCESSED 13

A. VARIATION OF REFUSE 14
B. SALVAGE 14

1. Paper 15
2. Metal 15

C. COMPOST PRODUCED 16

1. Sales 17
2. Contributions 17

D. USE OF SLUDGE 17
E. INCOME 18

-III- REPORT ON EQUIPMENT 19

A. TRUCK SCALE 19
B. APRON CONVEYOR 19
C. OSCILLATING CONVEYOR 20
D. SORTING CONVEYOR 20

ITEM PAGE

E. PAPER SALVAGE SYSTEM 20
F. PRIMARY GRINDER (Centriblast) 21

  1. Hammers (General) 21
  2. Hammers (Wear & Rebuilding) 23
  3. Capacity 24
  4. Dirt Problems 24
  5. Bearings 25
  6. Electrical 25
  7. Miscellaneous Items 26
  8. Summary 26

G. BALLISTIC SEPARATOR 27
H. INTERMEDIATE CONVEYOR 28
I. SECONDARY GRINDER (Williams) 28
J. MIXING SCREWS 30
K. SLUDGE SYSTEM 30
L. AUTOMATIC MOISTURE SENSOR (Honeywell) 30
M. TRANSFER CONVEYOR 31
N. MAGNETIC SEPARATOR 32
O. CAN CONVEYORS 32
P. TRIPPER BELT 32
Q. TRIPPER 33
R. AGI-LOADER 33
S. DIGESTION AIR SYSTEM 35
T. FINISHING SYSTEM 36
U. BURNER 37
V. METAL PELLETIZER 38
W. ROLLING EQUIPMENT 38

  1. Front-End Loader 38
  2. Fork Lift 38

-IV- OPERATING COSTS 38

A. MAINTENANCE 38
B. REPAIRS 39
C. ELECTRIC POWER 39

-V- LIST OF VISITORS TO COMPOST PLANT May 1, 1968 - August 31, 1968 40

-VI- TECHNICAL EVALUATION (Developed by Environmental Engineering, Inc.) 44

A. INTRODUCTION 44

ITEM	PAGE
B. CHEMICAL EVALUATION	47
1. Determination of Carbon	47
2. Determination of Phosphorous	49
3. Determination of Potassium	53
4. Determination of Nitrogen	54
5. Results	54
C. IN-PLANT INSTRUMENT EVALUATION	56
D. MICROBIOLOGICAL EVALUATION	59
1. Methods	60
2. Results	60
E. ARTHROPOD AND RODENT CONTROL PROGRAM	64
1. Rodents	64
2. Roaches	66
3. Flies	66
F. DISCUSSION AND PLANS	67
1. Sampling and Sample Preparation	67
2. Chemical Analysis	70
3. In-Plant Instrumentation	70
4. Microbiological Analyses	71
5. Pest Control	74
6. Development of Methods for the Determination of Compost Maturity	75
G. PROJECT STAFFING AND WORK TASKS	77
1. Technical Supervisor	77
2. Microbiological Technician	77
3. Chemical Technician	77
4. Electronics Technician	78
5. Additional Personnel	78
H. SUMMARY	78

TABLES

NUMBER	ITEM	PAGE
1.	Analytical Precision of Carbon Test	48
2.	Color Development in the Phosphorus Test	51
3.	Analytical Precision of Nitrogen Test	54
4.	Averaged Carbon and Nitrogen Content of Waste	55
5.	Coliform Indices in Compostite Samples	61
6.	Survival of Fecal Coliforms	63
7.	Characteristics of Salmonellae Isolates	65

APPENDICES

APPENDIX	ITEM	PAGE
A.	TONS OF REFUSE RECEIVED	80
	1. May	80
	2. June	81
	3. July	82
	4. August	83
B.	PROCESSING AND SALVAGE CHART	84
	1. May	84
	2. June	85
	3. July	86
	4. August	87
C.	COMPOST PRODUCED AND DISTRIBUTION	88
D.	CALORIFIC VALUE OF A SAMPLE OF "REJECT MATERIAL" FROM THE COMPOST PLANT	89
E.	PROPOSAL - CENTRIBLAST CORPORATION	90
F.	OPERATING COST PER TON OF REFUSE PROCESSED	94
	1. May - June	94
	2. July - August	95
	3. Total - Four Months	96
G.	SUMMARY OF CHEMICAL ANALYSES	97
H.	DAILY COLIFORM INDICES	98
	1. Raw Ground Refuse Moistened With Water	98
	2. Raw Ground Refuse Moistened With Sewage Sludge	98
	3. Compost With Sewage Sludge	99
	4. Compost Without Sewage Sludge	99

-I- GENERAL PROGRESS

A. OPERATIONS: Since our last interim report, which covered the period from January through April, the momentum of the project has stepped up considerably. During the month of May, the City of Gainesville brought in refuse 6 days a week with the exception of May 6, 7 and 8. This was due to needed time for some miscellaneous repairs on the secondary mill and the tripper conveyor. These porblems are taken up under section III, Report on Equipment. The collections from the city included all trash which was picked up on Wednesday and Saturday.

The County of Alachua also brought in refuse five days a week for the month of May. The University of Florida did not start their deliveries during May, as they still had a hole at their own private landfill which they wanted to fill. However, we did take in one of their packer trucks as a trial load, to see what the consistancy of their refuse would be.

June was a full month, with the exception of the last week, when we shut down for further modifications to the Centriblast Mill (our primary grinder). As you will recall, as mentioned in our first four month report for 1968, the Centriblast gave us most of our problems during the shake-down period. While a lot of modifications have been made, and these will be covered under section III of this report, we continue to be plagued with down time because of the Centriblast.

As July started, we could see some problems arising, due to the shortage of operating funds. A decision was made to close the plant down on July 19, 1968 until such time as actual funds were in our hands for operating the plant, and also that we would receive confirmation that funds would be forthcoming for the balance of the year. The plant was closed for the period between July 19 to August 27, when operations were resumed.

It was necessary to lay off our whole operating crew, including all maintenance men, with the exception of our Plant Superintendent. He stayed on to take care of general maintenance, as well as removing some of the digested compost. During this down time, reorganization of the operating crew was accomplished as far as the number of men and pay scale was concerned. This was an all out effort to keep within budget when operations were to resume.

1. Problems: The basic problem during the period of this report, particularly the months of May and June, was the quantities and nature of the trash which the city was bringing into the plant. The machinery in the plant was basically designed to take all garbage and trash consisting of leaves, grass clippings, shrubbery prunings and small branches 2 to 3 inches in diameter and not over 3 feet long.

However, during May, we received, every Wednesday, trash amounting to well over 100 tons, plus what was mixed in with the regular refuse on Thursday and Friday. Then in June, the trash deliveries increased even more. Besides the 100 plus tons on Wednesday, between 50 and 100 tons were delivered on Saturday, as well.

What we were receiving was tree branches 6 to 8 feet long, mixed in with oak logs as large as 24 inches in diameter, together with whole tree root systems, refrigerators, washing machines, matresses, bed springs and this was all entwined with moss. Then, there was the regular items of trash, such as leaves, grass clippings, shrub prunings and pine needles. These items, alone, were not too much of a problem, but when mixed with the larger items, made it hard to sort. The large appliances, we were able to pull out before entering the plant. However, the other masses of material gave us quite a problem, as it was almost humanly impossible for the sorters at the picking table to pull it apart before it entered the primary grinder. Once it hit the primary grinder, the Centriblast bogged down under the load. So, it became necessary to stop the picking conveyor long enough to pull all the material off and put it into trucks to haul it away to the landfill.

We were actually only grinding about 3 hours out of every 8 which made it necessary to run into a lot of overtime - as much as 4 to 5 hours a day. At time and a half, this really put a crimp in our budget. The first week in June, we went to two shifts to ease the burden on the men. This, then increased the working crew from 22 to 34 men and of course, they went on straight time. However, the payroll shut up again. The purpose for all this was to cope with the heavy loads of trash which was being delivered.

The last week in June, we closed down for what was supposed to be the final modification on the Centriblast. This will be discussed under section III. At this time, it was decided, after conferring with the president of the Authority, not to accept so called trash for the present time until some thought could go into how best to handle this situation.

2. Changes: There were a few areas of minor changes during this period of operation. These will be mentioned here briefly and further discussed under section III of the report:

   a. Discontinue use of Noll Mill for

peletizing the tin cans.

b. Changing of the tripper belt to a larger size.

c. Relocating the magnet separator.

d. Placing a new magnet before going into the regrind mills.

B. ODOR COMPLAINTS: A few odor complaints came in either directly to the Authority office or through the County Health Department. These started to come in during May and then eased off, but in June, they were far more frequent.

1. Reasons: The complaints in May were rather minor and did not persist as we discovered the reason for the odors rapidly. The blowers for the air system kicked off over a week end and lack of air and oxygen caused the batches on one tank to go aneroebic. However, as soon as air was once again restored, the odors disappeared. The complaints in June were a little more serious. The odors became more pronounced had we, here at the plant, could not determine why. The air was on all the time and the temperatures in the material were up. However, we noticed a seepage of liquid coming out of the bottom of the tank and this began to cause a fly breeding problem.

2. Solutions: Due to lack of experience on such

matters, Mr. Jerry Vaughn, manager of the Metro-Waste Plant at Houston, Texas, was sent over here to see if he could determine rapidly what our odor problems were. What had happened was too much moisture had been put into the material before it was put into the digestion tanks. This had drained down through the piles in the tank and started to seep out at the bottom. As the tank was emptied of the compost, it was discovered that a 2 to 4 inch crust of compost had formed on the bottom of the tank. This kept the air from penetrating through and into the piles to keep it aerobic. A small roto-tiller was purchased to break this crust up and allow the air to pass through freely.

We had relied on a Honeywell Moisture Sensing Instrument to regulate the amount of water or sludge being introduced into the compost. This instrument was found to be a very inaccurate way of measuring moisture, therefore, it was abandoned. Refer to section III for complete details.

The solution was relatively simple once we knew the reason for the problem. Now, about once a month, we agitate the bottom of our tanks to be sure we have a free air movement at all times. We are also more careful and a little more critical about the amount of moisture that is added to the compost. At first, we thought it was essential to have about 60% moisture, but found we were getting about 70%. Now we get good results with between 45 to 50% moisture. We get good digestion and the temperatures build up just as fast to the level (150 to 170 degrees F) which is considered desirable by most authorities in composting. Not only that, but regrinding is accomplished easier and with less wear and tear on the hammers and screws when the material is drier.

C. PERSONNEL: It was mentioned that Mr. Jerry Vaughn, manager of the Metro-Waste Plant in Houston, Texas, came over to help solve our odor problems. As everyone knows, composting is a relatively new field and experienced help is short indeed. Therefore, it was thought wise to have Mr. Vaughn stay at Gainesville for a time so that we could take advantage of his experience. He took an active part in helping us to train our personnel.

1. Shifts and Wages: During the period of the first week in June when trash collections were so heavy, we were running an average of 26 men and they were working anywhere from 4 to 6 hours overtime daily. A lot of time was due to mechanical problems still being ironed out; particularly in the primary grinder. These

will be further discussed in section III. Part of these problems, however, were related to the inefficiency of the machine to take the large amounts of trash coming in. This amount of work was found to be too much for the men, so 2 shifts were started on June 10th. This jumped our payroll to 34 men for the 2 shifts. At the same time, it brought the payroll to such an unreasonable level to expect to live with, particularly in light of what the Public Participants were paying for the service. Our average weekly payroll, with the two shifts, ran $4,220.00. This was for hourly personnel only. An additional sum of $646.00 per week was expended for office and supervisory personnel (Project Director, Superintendent, Bookkeeper and Secretary-Clerk). It was at this point that the decision was made to cut off all trash and try to get back on firm ground again and get the budget brought in line.

At the same time Mr. Vaughn was here, Metropolitan also brought up from the Largo, Florida, Pilot Plant, a man with lots of practical experience, Mr. Herb Beaddle. Together, these two men worked closely with our men in the different areas and passed along their experience to help us get a smoother, more trouble free operation.

As mentioned before, the plant closed down July 19th, so we took the opportunity to rework the budget to come up with the absolute minimum that the plant could possibly operate within in an efficient manner and still keep the inside of the plant, as well as the grounds, clean. We proposed to keep the new budget at a minimum of $1,500.00 weekly for the hourly people only. An additional expenditure of $819.00 per week goes for supervisory and office personnel. This is a little higher than before the plant shut down, due to the fact that two plant supervisors were shifted from hourly to regular salary. The salaried personnel consists of the Project Director, the Superintendant, the Maintenance Foreman, the Chief Electrician and the Secretary-Clerk.

On the following page, you will find a wage and man power schedule before the plant shut down and after it reopened.

AREA	No. of OPERATORS		Wages RATE PER HOUR	
	Before	After	Before	After
Picking	6	6	1.60	1.60
Laborers	6	2	1.60	1.60
Front End Loader	1	1	1.85	2.10
Baler Fork Lifter	1	1	1.85	2.00
Tripper	1	1	1.80	1.70
Agi-Loader	1	0	1.80	0
Regrind	2	2	1.80	1.70
Console Operator	1	1	1.85	1.85
Maint. Foreman	1	1	3.75	3.75
Electrician	1	1	3.50	3.13
Maint.-Class A	2	1	3.50	3.00
Maint.-Class B	3	2	3.25	2.80
	26	19	55.95	37.23

It is too early to tell how this new schedule will work out as the plant has only been back in operation for one week in the period covered by this report.

In the 1967 Annual Report, it was mentioned that a truck driver was employed for hauling away non-compostables out to the landfill. The Authority never did obtain a truck, so this job was let out to Grizzell Transportation Co. at a fee of $250.00 per week on a five day basis, or $300.00 per week for six days. This service consisted of two trucks and one driver. We felt that, in the long run, this service would be more economical, because the trucking firm stands the cost of maintenance, repairs, insurance and license.

2. Injuries: It might be mentioned here that the accident rate has been rather low, for which we are thankful. However, we did have one bad accident where one of our maintenance men had his arm broken while working on one of the many modifications for the Centriblast. This happened while rigging up a pipe overhead to support a come-along for picking up and lowering heavy material into the Centriblast. A pin had to be put in the arm, which took a four hour operation. The accident happened in May, and the arm is still in a cast and will be until January, 1969.

   One of the previous injury problems has been virtually eliminated - that of the men on the picking table being stuck with hypodermic needles. These usually came in large colored plastic bags with other materials from the hospitals. Instead of opening these bags now, they are thrown out with non-compostables. This problem has not bothered us since we started this procedure.

D. MARKETING: To date, compost from the Gainesville plant is being produced in bulk form only. Because a definite market has not been established as yet, the product is being put into storage piles for aging, as is, without any attempt to clean up.

Mr. Paul Simmons, an agricultural consultant, has been put to work in the Florida area and he is agressively contacting growers in the state to try to establish a market for the Gainesville compost. Mr. Simmons has moved several hundred tons, much of which will go into experimental plots for evaluation. He is working very closely with Dr. Charles Hortenstine of the Agricultural Department of the University of Florida.

A considerable amount of compost has been donated by the Authority to both the City of Gainesville and the University to use experimentally. The city has used their supply in developing new park areas and around the grounds of the new City Hall and library buildings. The University has used large quantities around their own grounds, particularly where new development is going on. Dr. Charles Hortenstine has used it on the various agricultural plots throughout the state of Florida, which are owned by the University.

Other areas of experimental use have been in the field of land reclamation and hydro-mulching. Compost has been sold to citrus growers and farmers in the state. On sales, the Authority gets $4.00 per ton F. O. B. Gainesville plant for unscreened material on a dry weight basis.

In the meantime, Metropolitan Waste Conversions Houston, Texas Plant has been experimenting and testing the bag market with some very interesting and encouraging results. The product in Houston has been marketed under the name "Alive" in an attractive plastic bag. Several hundred bags have been put into a few super markets on a test basis with no promotion and the results have been fantastic. On the strength of these tests, a million bags of "Alive" have been pre sold for the year 1969, to go into some of the largest super market chains in the country.

-II- AMOUNT OF REFUSE PROCESSED

The amount of refuse processed monthly has varied greatly, partially because of the shut down time during the shake-down period, the extensive training period and also the most recent shut down due to lack of operating funds. In the original grant application, it was estimated that the city would average 90 tons of refuse per day, the county 25 tons and the University 25 tons per day. This would be a total of 140 tons per day. To date, the County and University have not come up to their capacity except for the University on one day in July when they had 33.7 tons. The largest single day the city had was 181.6 tons in May. The city has averaged consistantly over the 90 ton estimation on a daily basis: May; 99.7 tons, June: 114.6 tons, July: 98.5 tons, August: 42.9 tons. The low August average was due to the shut down period between the 1st and 26th of the month.

A chart has been prepared showing the tons of refuse received on a daily basis for each of the 4 months. These charts are referred to as Appendix A.

A Processing and Salvage Chart is also enclosed for each of the four months and referred to as Appendix B.

A. VARIATION OF REFUSE: Refuse varies in consistancy from day to day and almost from week to week. We know, of course, that Monday and Tuesday are the heavy days, as there is a large accumulation of weekend newspapers. The 3 to 4 dumpmaster trucks, which usually pick up from the commercial areas and apartments, are usually loaded with cardboard Monday and Tuesday. There appears to be very little raw garbage as such on any one day. But this can also vary. There are a few days when a lot of garbage comes in. Unless there is a lot of heavy rain, the refuse is unusually dry.

Trash, as mentioned before, has been a consistant problem. This was supposed to have been delivered one day a week on Wednesday, but it also was brought in on Thursday, Friday and Saturday. After the last modification was made on the Centriblast, at the end of June, trash was eliminated from our collections, easing our problems considerably.

B. SALVAGE: The only item, at present, that is being salvaged for monetary value is paper. Tin cans, at this time, have no value in Florida in their present condition. Most of the other metal is being disposed of with the non-compostable items such as plastics, rags, rubber and leather.

1. Paper: Paper production varies as to the number of men on the picking table pulling paper and cardboard. The bales are mixed, including both newspaper and cardboard. Production also varies with the fact that it has rained a lot or has been dry. If papers come in too wet, we dare not compress it in bales because of heat and combustion. On trash days, of course, there is scarcely any paper. Our papers are baled in a Maren Baler, Model 72-S, which gives us a bale size of 60"x30"x42". If straight paper is baled, we get a weight of about 1100#. All cardboard gives us about an average weight of 650#, but the mixed bales, as we are doing them, will average in the area of 900#. Refer to Appendix B for the monthly data on number of bales, tons of paper, percentage of total intake and dollar value.

   At the present time, the paper is being sold to the U. S. Gypsum Co. in Jacksonville, Fla. They are reprocessing it and using it for backing on their gypsum board. During this four month period, the paper price has increased from $15.00 per ton to $19.00 per ton F. O. B. the Gainesville plant. The paper being extracted here is a good quality paper and has not presented any problems to U. S. Gypsum in their processing.

2. Metal: Refer again to Appendix B for the monthly

percentage and weight of cans being pulled out magnetically from the production line. To elaborate a little more on metal, we can say that this market has been investigated. In the first place, our aim was to burn the cans to clean them up. However, our burning facilities have not been finalized as yet, due to the lack of a scrubber for the burner. Engineering has has not been finalized on this feature. At any rate, upon investigation, the metal might be marketed if it could be burned. There is no use for the metal in Florida and Alabama would probably be the closest area it could be used. The approximate value, which we received from a metal broker is in the neighborhood of $20.00 per ton. Freight would eat up about $12.00 per ton of this and a local dealer would want about $4.00 per ton for the hauling. This would leave $4.00 per ton for the Authority and it is questionable, at this point, if we could salvage the metal and clean it up for this money. Therefore, until further study and information can be gathered, metal will continue to go to the landfill.

C. COMPOST PRODUCED: The tables shown in Appendix B indicate the amount of compostable material going into the digestion tanks. Appendix C shows a table of compost produced for the four month period, together with sales and contributions of compost made to the public participants. Based on the figures in this table, it is indicated that the four month average of compost out is 86% of the compostable materials put in.

1. Sales: Sales have been rather negligible for this period, however, as pointed out in Section 1 under Marketing, work is being done to develop the market. The compost sold, to date, is being put into test plots, particularly in the citrus industry. It is being sold for $7.00 per ton on a dryweight basis. This price includes cost of sales including sales commission. An additional charge is made for delivery and spreading, if the buyer needs this service.
2. Contributions: The contract with the public participants calls for a donation of 15% of the output of compost to be donated as follows: 7½% to the University of Florida to use as they see fit; either on their own grounds or on test plots throughout the state, and 7½% divided between the city and the county. The city has used their contribution in developing a new park area and also in the planting area of the new City Hall and library building. Appendix C details the quantity of compost given to the participants and also the amount of sales, to date.

D. USE OF SLUDGE: Up until June 5th, water was used as our

our moistening agent, but as of this date, we started to use digested sludge. Sludge in the amount of 189,173 gallons was added to 2,092 tons of compostable material going into the digestion tanks; or 90 gallons per ton. The sludge being used is a 4% solids content. The use of sludge created a few problems for us, however, as it was hard to control the amount of moisture being added. The presence of rags in the sludge caused countless jam ups at the valves. At times, we got no moisture and when we would open the valves up to increase and unplug the lines, then we received too much moisture. The fact that we had too much moisture most of the time was what created our odor problems in the digestion tanks. We tried installing micro switches on the transfer belt to shut off the moisture when there was a lack of material on the belt. At the same time, out at the Moyno Pump location, we had solenoid valves installed to recirculate the sludge back into the tank when the micro switch shut off the solenoid valve coming into the plant. This did not work, as the solenoid valves were constantly jammed up with rags. After June, we discontinued the use of sludge and went back to using water.

E. INCOME: As has been mentioned before, the Authority's only source of income outside of the fees being paid by the public participants, has been from paper and the small quantity of it that has been sold. As indicated in Appendix C, the sales of compost for the four month period was 331.3 tons. The fee for compost sales is based as follows and stated in the Sales Agreement between the Authority and Metro-Waste Corp.: "Metro-Waste shall pay to the Authority, 80% of net sales income realized by Metro-Waste from the resale thereof, but in no case shall the price paid by Metro-Waste to the Authority be less than $4.00 per ton for bulk compost.".

The value of the paper sold during this period was $3,728.40 and again based on the Sales Agreement; 2/3 of this amount comes to the Authority. This amount then is $2,483.11. The quantity and percentage of paper is recorded under Appendix B.

-III- REPORT ON EQUIPMENT

The first interim report for this year dealt with any major problems encountered during the shake-down period and the alterations and adjustments necessary to correct the problems. This report will discuss whether these adjustments have solved the problens and if any new problems have been encountered.

A. TRUCK SCALE: The only problem originally reported on the Toledo Scale was that of the card reader dropping figures and not recprding the proper weights. Toledo ordered a new reader and this finally arrived and has been installed. The scale has been operating in a satisfactory manner since then.

B. APRON CONVEYOR: We mentioned previously that on occasions, the motor had to be reversed to unjam the material bridging over the oscillating conveyor. This rarely happens now that trash was eliminated, however, we installed a reversing switch so as to facilitate the process when it was necessary. Maintenance has been practically nil on this piece of equipment.

C. OSCILLATING CONVEYOR: This conveyor does an adequate job under ordinary circumstances. However, when trash is dumped onto the conveyor, it will not vibrate the large globs loose to give us an even, uniform flow as is supposed to be on the picking belt. When we stopped taking trash, this situation cleared itself.

D. SORTING CONVEYOR: At the time of the last report, 2" wide strips of rubber belting were fastened to the conveyor to keep material from slipping. This solution corrected the situation then and it has continued to do so through this period.

A comment could be made here in reference to the sorting platform. It might be good, in the future, to provide for a shute or bin to handle the salvage of scrap metal. There was nothing provided for this and we have tried, in a crude way, to construct a metal hopper to hold this material, but space does not allow us an efficient system.

E. PAPER SALVAGE SYSTEM: This system has continued to perform well. Our baler operator has increased his efficiency, however, as the average weight of the bales is now about

925 pounds compared with the first report which showed 750 pounds per bale. The wire tying machine furnished by the U. S. Steel Company occasionally binds on us, but we always have a spare handy. When this happens, we ship the faulty machine back and another one is sent to replace it.

F. PRIMARY GRINDER (Centriblast): As reported previously, the Centriblast presented many problems. Even though many modifications have been made to correct these problems, it is still probably our major bottle neck.

1. Hammers (General): A complete new hammer and star shafts were installed at the end of April. This has been a big improvement over the original hammer shaft. However, there are still a number of problems in this area and they are costly ones.

   a. There are six banks of hammers with four hammers to each bank. The hammers are slipped onto a two inch shaft and the shaft is supposed to be held in with a ring clip. The ring clip is very unsatisfactory, as they spring out during operation. On one occasion, two hammers slung out of the machine and went into the secondary mill, causing extensive damage to the grates. To hold the shafts in place, we have to weld large washers over the ends. This is time consuming, as they then have to be burned off to get the shafts out again.

b. Another problem is that the shafts have a tendency to bend under pressure from the swinging motion of the hammers. This creates a big installation problem. It takes a minimum of 16 man hours to change a complete set of hammers and has taken as long as 24 hours. This job should be done in no more than 8 hours.

c. One final problem with the hammers is the particle size we are getting from the grind. The original contract calls for particle size to be approximately six square inches. We got good particle size out of the original hammer shaft, but could not live with the hammers because of the problems involved. We are now getting a particle size of from 6 to 12 inches. There are some exceptions. Occasionally, we will find whole magazines which have hardly been touched, a while newspaper which can be read after passing through the hammers and large 24 inch pieces of cardboard.

2. Hammers (Wear and Rebuilding): Hammer wear is somewhat better with the new removable type than it was on the original shaft. We attempt to change the hammers about every 1000 tons of refuse processed, however, it is hard to keep to a definite schedule because of the length of time it takes to make the change. It does not seem to make any appreciable amount of difference in particle size whether a new set has been put in or whether there is 1000 tons of wear on them. It will be hard to come up with an accurate per ton cost because we cannot always change the whole set at one time, therefore, some of the hammers may have processed 1000 tons of refuse and others, 1500 tons. We will attempt to arrive at a close cost based on an average of 1000 tons processed.

As previously reported, we were using an expensive rod which we thought would give us longer wear, but this did not prove out. We have now gone to a much less expensive welding rod and are using this one on all of our hammers. We build up the hammers with Magjet 3/16 Rod costing $.38 per pound. This is made by Lincoln Electric Company, Cleveland, Ohio. Then we are using a 6-IP, 5/32 rod costing $.62 per pound for hard surfacing the hammers. This is made by Alloy Rods Company, a division of Chemetron Corporation, York, Pa. It is taking 35 man hours to build up the hammers. A total of 163 pounds of Magjet Rod and 36 pounds of hard surface rod are being used.

Labor Welding	- $ 98.00
Ins., Workmans Comp., etc.	- 14.70
Welding Rod	- 86.16
Labor Changing Hammers	- 76.20
Total Cost of Maintaining Hammers	- $275.06

3. Capacity: The designed capacity of the Centriblast, which was 20 tons per hour, is now giving us a satisfactory feed. With dry material, we are averaging about 17 tons per hour and with wet material, we are averaging about 20 to 22 per hour. This is based on tonnage being delivered into the plant before salvage and picking non-compostables. This is a definite improvement since the new hammers were installed.

4. Dirt Problems: The installation of an overflow screw and hopper, mentioned in the last report, has helped in catching the dirt dropping out of the feed conveyor, but it presents a plug-up problem from time to time, as wire and rags catch on the screw. If we are careful to clean the

screw every morning before start-up, we omit most of the problem.

5. Bearings: At the time of the first report, this was a major trouble area, due to the location of the bearings. The problem was dirt being forced into the bearings and burning them out. To counteract this problem, Centriblast made another major modification - that of changing the side plates on the machine. This was done the last week in June. The original steel plates were only about 1/8 inch thick and these were being bulged outward by the force of material feeding through the hammer shaft. This opened up seams and joints in the plate and as the bearings were tight against the plate, dust and sand from the refuse was literally forced into the bearing despite the type of seals used. The new side plates were constructed with ½ inch steel plates and flashings were put over the joints to help prevent dirt from filtering through. This was a major operation to perform, but it appears that during the period of this report, a definite improvement has been made. However, due to the lengthy shut down during July and August, enough time has not lapsed to fully evaluate the effect of this change.

6. Electrical: Electrical problems have been

completely ironed out for this period.

7. Miscellaneous Items: One of the miscellaneous problems was the wear or rather lack of wear the lower feed track gave us and this was corrected by Centriblast, furnishing us with a new, heavy duty track. This seems to be standing up well. However, the top track is giving us problems now for the same reason - material too light and it will not hold its shape. Pins keep breaking in the chain sections. This will also be replaced by Centriblast in the near future, according to their verbal agreement.

8. Summary: It was indicated in the last report that a sum of $9,906.81 was spent through that period to keep the disintergrator in operation, to say nothing of down-time. Through the period of this report, an additional sum of $3,636.84 has been spent for a total expenditure of $13,543.65. We would have to state, at this time, after a fair trial of 8 months, that the Centriblast has turned out to be a very disappointing piece of equipment.

No doubt everyone reading these reports is aware of the fact that the Gainesville Authority is a demostration facility. Inasmuch as federal funds are being used here, it is the desire of the U. S. Public Health Service to get a full evaluation on each piece of equipment used in the plant. Therefore, they have requested that we present the facts as they are. We are including as Appendix E, a copy of the Centriblast Corporation Proposal.

G. BALLISTIC SEPARATOR: The ballistic separator did not function properly during the period of the first report. After the hammer change in the Centriblast, it was decided to give it another chance, figuring with the new type of hammers, the Centriblast itself might give us a better separation by slinging the heavier materials, principally metal, up onto the metal reject belt. New adjustable baffle plates were again installed and varied in position, but we still did not get a satisfactory separation. We estimated that only about 20% of all metal was being removed by ballistic separation. Another factor in discontinuing the use of this piece of equipment was the fact that so much compostable material was going out with the metal.

In connection with this, the air system has still not been put into operation. The last report stated the amount of paper which was being drawn from the ballistic separator to the burner was only about 320 pounds per hour, which we considered a rather small amount. A sample of the paper was taken from the burner and taken by Mr. John Ruf of the Public Health Service, to Cincinnati to determine the calorific value of it. This was done in order to gain some idea of the heat that would be generated during its combustion in the burner. The results of this test are found under Appendix D. No further work has been done in connection with the air system.

H. INTERMEDIATE CONVEYOR: This is the conveyor which feeds from the primary grinder into the secondary grinder. As previously reported, this conveyor has functioned without flaw.

I. SECONDARY GRINDER: The Williams Hammer Mill, Model GA-70 generally speaking, continues to operate with only the ordinary maintenance required, such as checking bearings, greasing and changing hammers. We did, however, have one maintenance problem during this period of time. The grates in the mill became badly bent. This was due, no doubt, to a number of factors. Firstly, the large particle size going into the mill at full capacity, having to be forced through 2½ inch spacing in the grates. This probably created enough pressure over a period of time to bow these grates out. With the grates bowed, the particle size coming through the Williams became larger. Secondly, the fact that a lot more metal passes through the Williams than was intended for it to do. The ballistic separator would have prevented this if it had worked efficiently; or the placement of the magnetic separator before the Williams Mill would help the situation.

At any rate, under the circumstances, the only solution was to remove the grates and have them straightened.

At one point back in May, we attempted to reduce the particle size coming out of the Williams. The particle size was averaging about 1½ to 2 inches with occasional pieces of cardboard and paper as large as 4 inches. To reduce the size, we removed the grates and welded 5/8" flat bar between the spaces to reduce the opening to the point where the material could not get through fast enough and therefore plugged the mill up. This happened even though only one half of the grates had been closed up. After a week of fighting these jams, we took the spacers out, opening up the grates to the full 2½ inch opening. Reduction of material size was not that much better either.

In the first four month report, we went into the types of welding rod used to resurface the hammers and the cost. It was shown that with expensive hard surface rod, our cost was too great to live with. The first report showed how the cost started out at $1.34 per ton and dropped to $.37 per ton by using a less expensive rod. This past four months, we have gone to a new type rod which gives us as good wear for even less money. This is the same type rod we are using on the Centriblast Mill. With an average of 3½ pounds of build-up rod and ½ pound of hard surface rod per hammer, this would make a cost of $42.64 for welding rod per complete set of hammers. The labor for applying the rod took 38 man hours at $3.22

per hour or a labor cost of $122.36. Total cost per set of hammers for grinding an average of 600 tons, not including the electricity to run the welding machines, is $165.00 or $.27 per ton.

For comparison's sake, we have omitted the cost of changing the hammers in the mill. At the time of the first report, these figures were not available. However, we now have determined that it takes an average of 7 man hours to change the hammers in the Williams Mill, which is an additional cost of $25.55. This brings the total cost for 600 tons to $.31 per ton.

J. MIXING SCREWS: The only problem encountered with the mixing screws was after the new Centriblast hammers had been installed. This gave us an increase in capacity to the 20 ton average the plant was designed for. When the increase in the feed came, the mixing screws began to overflow. They were not moving the material out fast enough. This was overcome by changing the sheaves to double and using double belts and speeding up the screws to carry meterial away faster. Since this change, the mixing screws have functioned with no problems other than normal maintenance. We have found it to our advantage to clean the wire and rags out of the screws on a daily basis just before start up each day.

K. SLUDGE SYSTEM: This was discussed in Section II under Use of Sludge.

L. AUTOMATIC MOISTURE SENSOR (Honeywell): This piece of equipment has continued to give us problems. What should have been a worthwhile solution to moisture problems turned out to be a nightmare. The moisture sensor was hooked up to a variable speed motor on the Moyno Pump. Two sensor probes lay on the transfer belt and rode over the material as it passed on to the magnetic separator. However, by the time the sensor probes passed along the message to the vari-speed motor, on the Moyno Pump, that there was too much moisture and by the time the motor slowed down, we were floating in water. The same was true in reverse. If the material was too dry, it took forever to get moisture into the system. The picture you get on the recording chart is like a paint brush sweeping back and forth the full width of the chart. The chart was supposed to give us the amount of moisture on a permanent basis, but we get no pattern on the chart whatsoever.

The Honeywell people have been out on numerous occasions to make adjustments, but it seems like the harder they try, the worse it gets. Up until this time, we have been unable to use this system with any success at all, therefore, we are relying on manual means to control the moisture.

M. TRANSFER CONVEYOR: This simple conveyor, between the secondary grinder and the magnetic separator, continues to function with no problems and only minor maintenance costs.

N. MAGNETIC SEPARATOR: The Eriz Magnet is doing a good job of separating ferrous metals, but we found that the position of the magnet, in relation to the hopper that catches the metal, was a little too far forward. Therefore, a lot of metal was falling onto the Tripper Conveyor and being discharged into the digestion tank. This created problems when we pulled the material out and sent it to the regrind mills, as we found several large pieces of metal going through the mills and damaging the screens and sometimes breaking a hammer. This situation was corrected by repositioning the magnet so as to throw most of the ferrous metal into the hopper intended for it. As far as the operation of the magnet itself, it functions with little or no maintenance problems.

O. CAN CONVEYORS: The 12 and 16 inch can conveyors removing the metal from the magnetic hopper to the outside of the plant have caused no problems other than normal maintenance. On a rare occasion, where the 12 inch conveyor dumps onto the 16 inch conveyor, the metal has jammed, but this is not a persistant thing.

P. TRIPPER BELT: It was indicated, in the last report, that the 18 inch belt, then in use, was undersized. With the conveyor as installed, it would take a 22 inch wide belt. This was done during May and has resulted in a much improved operation. The bottle neck where the material dumped from the transfer belt onto the tripper belt has disappeared. The clean up problem has eased considerably between the tanks, although, there is still some spillage off of the belt when a heavy flow of material is on the belt. It would not hurt in the least to have a belt as large as 30 inches in this location in the future. It would save a lot of clean up man hours and would, at the same time, keep the rollers from becoming surrounded with dirty, wet material, thus prolonging their life. The rollers or idlers have sealed (life time) bearings in them, yet, when they get wet, the bearings go. We have had to replace quite a number of them. However, the situation is much improved in all ways with the installation of the 22 inch belt.

Q. TRIPPER: Tripper modifications, as mentioned in the previous report, have worked out very well to date. This modification was to convert the shuttle conveyor to a swivel type and to put a four wheel drive on the machine. The basic problems have been solved and it is much simpler to operate. Due to the dirty, dusty nature of the product, we have burned out 2 or 3 motors, which drives home the necessity of using fully enclosed motors in the future. Occasionally, the drive chain will jump off the sprocket, but basically, the problems now are general maintenance problems.

R. AGI - LOADER: At the time of the last report, we indicated that, while unloading compost from the digester tanks, we were cutting into one third of the pile with the agi-loader. Since then, we have done some more experimenting by trying a full cut, a half cut and back again to the one third cut. The full cut seems to be too much for the agi-loader to handle, as it puts too much of a load on the electric system, thus blowing fuses. Not only that, but too much material is loaded onto the belt and in return, an overload results in the two regrind mills. Even a one half cut is a little too much feed for the regrind mills. It has been proven that we get more consistant running time by using the one third cut, thus eliminating down time due to clogging of the delivery screws or overloading of the regrind mills. Detention time for compost in the tanks has been about 10 days.

We have not attempted to agitate any material during the period of this report, before removing it from the tanks. However, this will be done in the next period.

The agi-loader, as a machine, will operate very efficiently. The main problem has been the operators or man power operating the equipment. Turnover of man power has been a problem and until a man learns to coordinate the operation of the agi-loader together with the regrind mills, he has problems with the clogging or overloading or both. Right now, we are operating the agi-loader on a two 8 hour shift basis. Assuming that we actually operate 6 or 8 hours, we can remove 60 feet of a full tank each 8 hour shift, or average 10 feet per hour for actual operating hours. One man has been operating both agi-loader and regrind mills during the day shift. If he has any problems, he can always receive help. However, the night man has a helper because these are the only men in the plant. The helper is in the regrind area and utilizes his time in general clean-up work. He is there in case of emergencies, to help the agi-loader operator.

S. DIGESTION AIR SYSTEM: When the plant first started up, the dampers and motor controls used on the air system worked satisfactorily. However, as time wore on, the pressure of air against the dampers weakened the motors to the point that the dampers, on one side, would not stay closed while the other damper was opened. The air system is designed to operate on half of the digestion tank at one time and when both dampers are opened together, the amount of air going in is cut in half. It was apparent that the damper motors were not strong enough to stand the constant pressure when the blower was on. In order to get the air system back to efficient operation and to protect the compost against going anaerobic, four new, more powerful dampers were installed. At present, the air system is functioning properly. We are using a total of about 12 minutes of air in each tank per hour. This is accomplished by having the blowers on for 6 minutes each half hour into each half of the tank.

At the present time, we do not know if this is the optimum amount of air needed for good digestion, but this will be established as soon as the evaluation equipment, namely the Honeywell Rolling Cart, is put into service. This will be discussed in the next four month report.

T. FINISHING SYSTEM: The finishing equipment consists of a series of conveyors and screws feeding into the two final regrind mills. From the regrind mills, material is dropped into a 24 inch screw and then conveyed to the bulk storage pile. Most of our problems, during this four month period, have been resolved and costs should be cut accordingly, in the future.

One of the major problems has been the amount of metal which has gotten into the mills. As this metal is whipped around by the hammers, the screens are pretty badly torn up. Screens cost $90.00 per set, plus installation, therefore, this can get quite costly. As mentioned under N of this section, the magnetic separator has been repositioned so as to remove more ferrous metal. Another magnet has also been installed over the incline belt, going to the regrind mills, so as to make a final effort to save the screens. This has proven to be very successful. Of course, there is still some non-ferrous metal which gets through, but we are now able to run a set of screens as long as three weeks before changing. This compares formerly with a set of screens being replaced as often as every one to three days.

One other problem has been the plugging of the #1 mill. This has been due to the way the mills are fed. Material drops from a 16 inch screw into two 12 inch screws, which, in turn, each drop into one of the regrind mills. Most of the material drops into the #1 mill and very little goes on into the #2 mill. This quite often results in a jamming of the #1 mill. To counteract this, we have installed some electric relays on both of the 12 inch feed screws. It works in this way. An amp meter is tied into each of the regrind mills. As material is fed into the #1 mill, the amp meter will automatically shut off the 12 inch feed screw, if and when the mill gets to an overloaded condition. This automatically forces more material into the #2 mill. Then, as the pressure is taken off the #1 mill, it will kick back on again. We are getting a good balance now with the #2 mill doing more work. This has solved the basic problem, but we go back to what was said about the agi-loader. Manpower can be a source of a lot of problems, such as neglect, carelessness, lack of knowledge, etc. A smooth operation at the finishing end of the plant is a matter of coordination between the agi-loader and the regrind mills, in learning to deliver the right amount of material to the mills. This training has come hard because of turnover in personnel, but, at this point, our finishing end problems have been basically licked.

U. BURNER: No evaluation has been made on the burner, as this equipment has not been put to use, due to various problems. One of them being that a market for the cans has not been established and the cost of running the burner and processing the metal would not be warranted.

V. METAL PELLETIZER: The last report indicated operating problems with the Noll Mill. Nothing further has been done with this piece of equipment. It has not been used during this period.

W. ROLLING EQUIPMENT: This equipment consists of the Caterpillar Front End Loader and the Hyster Fork Lift.

1. Front End Loader: This machine has been an efficient, low cost maintenance performer. The original tires are still in operation, but are pretty well worn. New tires have been ordered, but will not arrive for about another month. The only other extensive maintenance work to be done is to replace the leading edge of the bucket which scrapes over the concrete all the time.
2. Fork Lift: No problems have been encountered other than normal maintenance.

-IV- OPERATING COSTS

We are not going to attempt to outline costs for every conveyor or minor piece of equipment, but for the major components only. These costs will be broken down into the following categories:

A. MAINTENANCE: This includes any material used in maintaining the equipment, such as lubricants and welding rods for surfacing hammers. Maintenance labor would be the application of the lubricant, applying the rod to the hammers, adjustment of belts and conveyors, cleaning motors and changing hammers in a mill. Labor would also include the operation of a particular piece of equipment which requires a man to be present at all times during its operation, such as the tripper, the agi-loader and the regrind mills.

B. REPAIRS: This would be either the cost of repairing worn or broken parts or the cost of new parts to repair a particular piece of machinery. Repair labor is the actual labor it takes to change or replace these parts.

C. ELECTRIC POWER: This is the cost of the power it takes to operate a piece of equipment based on the voltage and amps of the equipment related to kilowatt hours of use. The information is taken from the monthly billing made by the City of Gainesville. The rate we used for figuring our costs is 2.5 cents per KVA - Hour.

Operating costs are detailed in Appendix F. Under Finishing Equipment, we have included all the equipment involved with feeding the digested compost into the final grinders. This consists of an incline belt feeding into an 18" screw. This screw distributes material into two 12" screws, which, in turn, feed into two regrind mills. The reground material is fed into a 24" screw to be carried off. All of these components make up the finishing equipment.

- V - LIST OF VISITORS TO COMPOST PLANT

MAY 1, 1968 - AUGUST 31, 1968

	NAME	DATE	FROM	REPRESENTING
1.	R. A. Lynn	5-2-68	St. Petersburg, Fla.	International Disp.
2.	Art Mohler	2	St. Petersburg, Fla.	International Disp.
3.	C. W. Lear	2	Tampa, Fla.	Westinghouse Electric
4.	Frank Rigo	2	Largo, Fla.	International Disp.
5.	O. W. Kochtitzky	2	Chattanooga, Tenn.	T. V. A.
6.	Gordon E. Stone	2	Johnson City, Tenn.	PHS - TVA Composting Proj.
7.	W. K. Seaman	2	Johnson City, Tenn.	T V A
8.	Harry Stierli	2	Cincinnati, Ohio	U S P H S
9.	John Ruf	2	Cincinnati, Ohio	U S P H S
10.	R. D. Ray	10	Tallahassee, Fla.	State Dept. of Education
11.	Lee Crews	10	Gainesville, Fla.	Game & Fish Comm.
12.	Doug Fletcher	10	Lake City, Fla.	Game & Fish Comm.
13.	T. L. Vaughn	10	Lake City, Fla.	Game & Fish Comm.
14.	Harry Taylor	10	Live Oak, Fla.	
15.	Dr. B. J. Gaffney	13	Stillwater, Minn.	Conwed Corp.
16.	K. Saehrison	14	Gainesville, Fla.	U of F, College of Nursing
17.	Jenny Graham	14	Gainesville, Fla.	U of F, College of Nursing
18.	B. J. Stephen	14	Gainesville, Fla.	Health Dept.
19.	M. Hess	14	Gainesville, Fla.	Health Dept.
20.	J. C. Vaughn	14	Gainesville, Fla.	Health Dept.
21.	Jack Hurst	21	Gainesville, Fla.	Health Dept.
22.	Russell White	20	Gainesville, Fla.	Student
23.	Stanley J. Pac	24	New Britain, Conn.	State of Conn.
24.	Mrs. Curtis Ter Kuile	23	Litchfield, Conn.	State of Conn.
25.	Leslie K. Sherman	23	Wethersfield, Conn.	State of Conn.

LIST OF VISITORS (Cont'd)

NAME	DATE	FROM	REPRESENTING
26. J. J. Kolega	5-23-68	Mansfield, Conn.	University of Conn.
27. Charles Kurker	24	East Hartford, Conn.	Conn. State Dept. of Health
28. Nancy Kinard	6- 3-68	Gainesville, Fla.	Student
29. Mike Galyen	3	Gainesville, Fla.	Student
30. Irving Fell	6	Bloomington, Ind.	Industrial Services, Louisville, Ky.
31. L. W. Lefke	28	Cincinnati, Ohio	U S P H S
32. John Kiker	28	Gainesville, Fla.	University of Florida
33. W. E. Bolch	28	Gainesville, Fla.	University of Florida
34. Wisut Ragthaidee	7- 3-68	Bangkok, Thailand	Bangkok Dept. of Health
35. R. C. Cerny	3	Cleveland, Ohio	H. K. Ferguson Co.
36. A. J. Bossert	10	Buffalo, N. Y.	W. R. Trautman Assoc.
37. Lonie Jones	11	Gainesville, Fla.	First Natl. Bank, Gainesvill
38. Robert Letterle	12	Bradenton, Fla.	
39. Richard Lossin	15	Johnson City, Tenn.	U S P H S
40. David Knuth	15	Gainesville, Fla.	Environmental Engr.
41. Nancy Ulmer	15	Cincinnati, Ohio	U S P H S
42. Thomas Furman	15	Gainesville, Fla.	University of Florida
43. Russell H. Susag	15	Gainesville, Fla.	University of Florida
44. M. D. Bogue	15	Atlanta, Ga.	U S P H S
45. Samuel Hart	15	Davis, Calif.	U S P H S
46. Nick Mastro	17	Jacksonville, Fla.	Fla. State Board of Health
47. Geo. Seiler	17	Hialeah, Fla.	Reynolds, Smith & Hills
48. J. A. Hammack	17	Jacksonville, Fla.	Reynolds, Smith & Hills
49. C. E. Plymale	22	Toledo, Ohio	Owens - Illinois

LIST OF VISITORS (Cont'd)

	NAME	DATE	FROM	REPRESENTING
50.	S. F. Caleam	7-22-68	Toledo, Ohio	Owens - Illinois
51.	T. R. Santelli	22	Toledo, Ohio	Owens - Illinois
52.	C. I. Harding	22	Jacksonville, Fla.	Reynolds, Smith & Hills
53.	Thomas C. Leslie	23	Cincinnati, Ohio	U SP H S
54.	Henry Hudson	23	Cincinnati, Ohio	U S P H S
55.	Daniel J. Keller	23	Cincinnati, Ohio	U S P H S
56.	Michael L. Senske	23	Cincinnati, Ohio	U S P H S
57.	W. Liberick	23	Atlanta, Ga.	U S P H S
58.	Truett V. De Geare, Jr	23	Cincinnati, Ohio	U S P H S
59.	L. P. Robinson	31	Jacksonville, Fla.	Fla. State Board of Health
60.	Jerry Martin	31	Jacksonville, Fla.	Fla. State Board of Health
61.	Kenneth D. Green	31	Victoria, Australia	River & Water Supply Comm.
62.	Charles W. Holmes	8- 2-68	Gainesville, Fla.	Soils Dept., U of Fla.
63.	B. E. Kane, Jr.	2	Gainesville, Fla.	University of Florida
64.	J. T. Mullins	2	Gainesville, Fla.	University of Florida
65.	M. Peterson	2	Cincinnati, Ohio	USPHS
66.	Dr. Dieter Strauch	2	Giessen, W. Germany	Univ. of Giessen, W. Ger.
67.	A. K. Williams	2	Athens, Ga.	F W P C A
68.	Wayne Sutterfield	5	St. Louis, Mo.	City of St. Louis
69.	O. Chichfee	5	Tampa, Fla.	Hills Co. Health Dept.
70.	Henry Woodard	5	Merritt Island, Fla.	Brevard Co. Health Dept.
71.	Ron Maston	5	Jacksonville, Fla.	Fla. State Board of Health
72.	David Williams	5	Tampa, Fla.	
73.	C. C. Rhodes	5	West Palm Beach, Fla.	Palm Beach C H D

LIST OF VISITORS (Cont'd)

	NAME	DATE	FROM	REPRESENTING
74.	John O. Welke	8- 5-68	Hialeah, Fla.	State Board of Health
75.	C. M. Senner	5	Bushnell, Fla.	Sumter Co. Health Dept.
76.	K. S. Manuel	5	Jacksonville, Fla.	Fla. State Board of Health
77.	W. C. Galbreath	5	Ft. Lauderdale, Fla.	Broward Co. Health Dept.
78.	Geo. M. Boyd	5	Tallahassee, Fla.	Leon Co. Health Dept.
79.	Leon W. Sheumaker	5	Jacksonville, Fla.	State Board of Health
80.	G. F. Page	5	De Land, Fla.	Volusia Co. Health Dept.
81.	E. C. Breth	23	Rochester, N. Y.	County of Monroe
82.	V. J. Smith	23	Loudonville, N. Y.	Monroe County
83.	Charles W. Holmes	29	Sarasota, Fla.	Sarasota Co. Health Dept.

-VI- TECHNICAL EVALUATION*

A. Introduction: The principal objective of the technical program of the Gainesville Demonstration Project is to provide the technical support required to demonstrate the satisfactory performance of the Metro composting system for the treatment of solid wastes from medium-sized cities. The specific objectives are to:

1) determine what is accomplished by the composting process,
2) evaluate the public health aspects of the process.

When these objectives are achieved, recommendations in the form of revised operating parameters may be made to improve the process. If the operating parameters are revised their effect on improving the process will be subsequently evaluated. Data resulting from the fulfillment of these objectives will be used by:

1) the U. S. Public Health Service to evaluate the utility of composting as a treatment process to partially alleviate the nationwide solid waste problem,
2) plant operators in the selection of process control parameters to attain more efficient treatment,
3) technical personnel in control and research work on solid wastes.

During the course of this demonstration project the Metro composting process, as an example of a high-rate composting system, is being evaluated for its utility in the treatment of solid municipal wastes. In general, but particularly in the United States, composting is an unproven process. The composting process must not only render the waste hygienic but also it must decompose the waste so that its further disposition will not cause environmental insults. If a useful product can be derived from the composting process, its sale might reduce treatment costs and thereby render the process somewhat more desirable than alternative processes. Influent waste consisting of raw garbage and refuse is obnoxious as judged by most standards. Because refuse is usually decomposing when received, it is odorous and attractive to rodents and arthropods. Also, it may contain organisms which are pathogenic or otherwise harmful to man, animals and plants.

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* Developed by Environmental Engineering, Inc.

The success or failure of composting therefore depends partially on waste decomposition which is rapid and fairly complete and elimination of potential health hazards associated with this process. The technical evaluation program is designed for these specific purposes. Because the processing of raw refuse and the ultimate use of compost may present health hazards, it is imperative to delineate these hazards so that protective measures can be established. The hazards associated with refuse processing include contamination of workers as a result of handling waste, by injury, or by inhalation of aerosolized microorganisms and particles. Thus, it is required of the technical program that raw waste, compost and the air surrounding dust generating machinery be examined for potentially hazardous microorganisms and particles. Similarly, the workers themselves are being examined for clinical manifestations of disease.

The hazards associated with compost use include possible contamination of soil with surviving plant pathogens and infection of personnel with human pathogens that might also survive the process. The declaration of compost as being hygienic is complicated by the great number of pathogens which are potentially present and the difficulty encountered in proving their absence.

Therefore, the common practice in this type of situation is to assay for a limited number of microorganism types and if these cannot be found, it supposedly is an indication that all pathogens are absent. Total coliforms, fecal coliforms, and the salmonellae were the indicator organisms used in this program. Samples of plant effluent were examined periodically for their presence.

Because arthropods and rodents are important vectors of refuse borne diseases, the technical program has as one of its objectives the study and control of nuisances caused by these pests. Short range control is dependent upon pesticide applications, whereas long range control will depend on methods developed during this investigation.

Process efficiency of the Metro system is determined by comparing chemical and physical properties of raw waste with those of plant effluent (compost). Similarly, these properties provide the basis for determining the quality of compost which is to be used for agricultural purposes. It is generally agreed that certain chemical changes occur during the composting of organic materials which indicate the stability of these materials. One of these changes is a decreasing C/N ratio with increasing treatment time. Analyses for additional elements, particularly potassium and phosphorus, indicate the nutritional value of the waste for plants and for microorganisms which decompose the waste.

Just as composting is an unproven process in the United States, methods for the analysis of refuse and compost are still under development. Work during this report period has shown the inadequacy of some sampling procedures and analytical methods. Consequently, this report includes plans for different procedures which should overcome previous difficulties.

The laboratory work was discontinued for a period of about 3 weeks. The principal reason for this was that the further collection of data by inadequate procedures was considered wasteful. Secondarily, the shut-down provided time to re-evaluate the technical program, to plan future work and personnel needs, and to order new equipment. When the laboratory was reopened the technical program was enlarged to better fulfill the project objectives.

B. Chemical Evaluation: The chemical analysis program has two primary objectives. The first is to describe the chemical changes which take place during refuse digestion and the second is to provide data relating to the potential value of the compost product. Changes in moisture content, carbon to nitrogen ratio, pH, oxygen uptake and carbon dioxide evaluation rates, temperature, and lipids content are among the parameters selected for study in conjunction with the first objective. Nitrogen, phosphorus, and potassium content, and pH of the compost relate to the value of the product. Some of these parameters, pH and nitrogen content for example, relate to both of these objectives.

A great deal of difficulty has been encountered; some due to limitations of the analytical procedures, some due to heterogeneity of samples, and some related to the nature of the refuse and compost. Most of the work to date has been directed toward resolving these problems.

1. The Determination of Carbon: In Table I are given the results of some of the analyses which were run in order to check the precision of the procedure for determining carbon.

TABLE I

ANALYTICAL PRECISION OF CARBON TEST

Description of Sample	Number of Individual Analyses	Percent Carbon
Ground Refuse	5	42.5 ± 2.32
Final Ground Compost	6	39.5 ± 4.70
" " "	5	38.7 ± 2.61
" " "	4	42.1 ± 2.30
Activated Carbon	6	81.3 ± 0.21
" "	4	77.9 ± 1.65
" "	5	79.6 ± 1.42
Final Ground Compost		
Re-ground to a fine powder	6	36.1 ± 0.98

Since the precision of this analysis, when applied to ground refuse and compost, has not been good, a sample of granular activated carbon was obtained which was thought to be more homogeneous. Even though the refuse samples had been dried and ground in a blender they were probably not homogeneous enough. The carbon analysis requires an extremely homogeneous sample because of the small amount of material (50 mg) analyzed. The sample size cannot be increased significantly because the combustion is very rapid and if an excessive amount of organic material is present in the crucible a small-scale explosion results which blows the sample and accelerator out of the crucible.

As Table I shows, the precision was improved considerably when a homogeneous sample (activated carbon or finely ground compost) was analyzed. The percent carbon determined for the activated carbon seemed quite low however; so a solution of disodium ethylene diamine tetraacetic acid (EDTA) was prepared and analyzed. Aliquots of this solution were pipetted into the platinum crucibles and dried at 75°C before analysis. The recovery of carbon from the EDTA was 100±2.2%. Apparently the percent carbon in activated carbon is lower than anticipated because even when moisture is accounted for the recovery is 90 percent or less.

Finally a sample of compost was finely ground and analyzed. The result (Table I) indicated that a properly prepared sample of compost can be analyzed for carbon content. A laboratory grinder has been obtained but it cannot be used effectively until a primary sample grinder and riffle are installed because the laboratory grinder will not handle large quantities of coarse material.

2. The Determination of Phosphorus: The procedure for the determination of phosphorus presented in the Appendix of Municipal Refuse Disposal was found to be inadequate in two aspects. First, the digestion suggested (25 ml of concentrated H_2SO_4) does not completely destroy the organic matter in compost. Second, the color development is not reproducible.

After several attempts to digest compost with sulfuric acid alone proved unsuccessful, some alternate procedures were tried. It was found that addition of mercuric oxide to the acid and compost caused destruction of all organic matter in a reasonable length of time; but that the mercuric oxide precipitated when the pH of the solution was raised. Removal of this precipitate was extremely difficult, and because it clouds the solution it must be removed before the colorimetric determination.

Addition of nitric acid (HNO_3) to the compost and sulfuric acid resulted in no improvement in the digestion. However it was found that compost can be digested on the hot plate by a mixture of 25 ml concentrated H_2SO_4 and 15 ml concentrated HNO_3 by adding potassium nitrate (KNO_3) in small portions as required. It was also found that digestion with 25 ml of concentrated sulfuric acid and 2 gm of potassium persulfate resulted in the complete destruction of the organic matter in the compost.

Samples were then prepared as described in Municipal Refuse Disposal and aliquots were taken for color development. Two methods of color development were tried, one described in Municipal Refuse Disposal using molybdate and elon and a procedure from Standard Methods for the Examination of Water and Wastewater, which differs in that stannous chloride (a stronger reducing agent than elon) is used with the molybdate reagent. Table II is a summary of results of the two color development methods. All compost samples were prepared by blending a quantity of compost with approximately 10 times its weight of water. Aliquots of this slurry were weighed into the Kjeldahl flasks for digestion, so that the samples should have been homogeneous. The column marked, "Standard Phosphate", refers to the amount of potassium dihydrogen phosphate solution added to each flask before digestion. In those cases where no

TABLE II

COLOR DEVELOPMENT IN THE PHOSPHORUS TEST

Sample Description	Standard Phosphate (ml)	Sample Size (gm)	Reducing Agent	O.D.	O.D.$_2$	O.D.$_3$	Digestion Method
Final Ground Compost	0	0.9	elon	110			KNO_3
" " "	0	"	"	49			"
" " "	0	"	"	75			"
" " "	0	"	"	91			"
" " "	0	"	"	61			"
" " "	0	"	"	150			"
				89.3±36.8			
Final Ground Compost	0	1.0	elon	94			$K_2S_2O_8$
" " "	0	"	"	118			"
" " "	0	"	"	147			"
" " "	0	"	"	337			"
" " "	0	"	"	158			"
" " "	0	"	"	145			"
				166.5±86.6			
Final Ground Compost	0	1.0	$SnCl_2$	90	93	104	$K_2S_2O_8$
" " "	0	"	"	104	115	126	"
" " "	0	"	"	106	115	127	"
" " "	0	"	"	69	84	91	"
" " "	0	"	"	100	129	121	"
" " "	0	"	"	121	184	147	"
					113±26		
None	0	0	$SnCl_2$	176	236		$K_2S_2O_8$
"	1	0	"	227	250		"
"	2	0	"	231	260		"
"	4	0	"	222	251		"
"	6	0	"	230	258		"
"	8	0	"	187	217		"
None	0	0	$SnCl_2$	99	150	146	$K_2S_2O_8$
"	8	0	"	151	197	198	"
"	8	0	"	214	265	266	"
"	8	0	"	60	102	102	"
"	8	0	"	130	169	170	"
"	8	0	"	58	110	109	"
					153.4±63		

compost was digested with the standard solution, approximately 1 gm of Whatman number 42 filter paper was added to the flask to similate the organic matter of compost. In some cases color was developed in second (O.D.$_2$) and third (O.D.$_3$) aliquots of the prepared sample to test the reproducibility of this step. Optical density (O.D.) is measured in Klett units, one Klett unit equals 1000 absorbance units.

The column marked, "Digestion Method", refers to the digestion procedure employed to destroy the organic matter. KNO_3 refers to the previously described method wherein the sample is digested on the hot plate with sulfuric acid, nitric acid and potassium nitrate as required. In the second digestion procedure the sample is combined with 25 ml sulfuric acid and 1.5 gm $K_2S_2O_8$ and digested on the Kjeldahl.

When color was developed in serial dilutions of the standard solution both methods of color development gave optical densities which were reproducible from aliquot to aliquot. The stannous chloride reducing agent gave the highest optical density at a given phosphate concentration. When the same standard solution was digested with filter paper and then treated to develop the color the optical densities were not reproducible. Apparently the residual digestion chemicals interfere with the color development. The ionic strength of the digested solution in which the color must be developed is quite high and attempts to reduce this ionic strength by dilution prior to color development would also reduce the phosphate concentration.

In August a sample of final ground compost was taken to Technical Services, Inc. in Jacksonville, Florida, for analysis by the Quimociac Method (Official Methods of Analysis, 10th Ed., A.O.A.C., Washington, D.C., 1965). Technical Services, Inc. allowed a chemist from the Gainesville staff to analyze the compost sample with their equipment. For nine separate analyses the average phosphate content (as orthophosphate) was 0.424±0.019%. Recovery of phosphate added to the compost in solution form averaged 94.4%. This method would appear to be the solution to the problem, and we are currently setting up to use it routinely.

3. The Determination of Potassium: The method of analysis for potassium recommended by Municipal Refuse Disposal has yet to be tried at the Gainesville plant. It is anticipated that the A.O.A.C. recommended procedure for potassium, which was tested at the same time that the phosphate method was tested, will be used. Only two analyses were run on compost. The average potassium content was found to be 0.23% (as K) on a dry weight basis. For ten other runs with from 12 to 50 mg potassium added per gram of compost the percent recovery of the added phosphate averaged 92.4. This method is adequately precise and is more convenient than the method described in Municipal Refuse Disposal since destruction of all of the organic matter is not required. Potassium is extracted from the organic matter by boiling for 30 minutes in 1% ammonium oxalate solution. We are currently equipping the laboratory to use the A.O.A.C. recommended procedure for the analysis of potassium.

4. The Determination of Nitrogen: The method for analysis of nitrogen described in Municipal Refuse Disposal has produced good results. The results have not shown the variations found in the analysis for carbon. Table III below represents some of the tests which have been done to find the precision of this method.

TABLE III

ANALYTICAL PRECISION OF NITROGEN TEST

Description of Sample	Number of Samples	Average Nitrogen Content percent
Ground Compost	5	0.399 ± 0.045
Ground Compost	5	0.360 ± 0.016
Ground Raw Refuse	5	0.493 ± 0.026
Ground Raw Refuse	5	0.479 ± 0.045
Ground Raw Refuse	8	0.497 ± 0.026

These deviations are acceptable.

Public Health Service chemists Richard Lossin and Nancy Ulmer have suggested that we substitute a chromium reduction procedure which would determine total nitrogen including nitrate nitrogen for the present procedure which does not determine nitrate nitrogen. This procedure will be investigated as time permits.

5. Results: A compilation of chemical data, including those for moisture, carbon and nitrogen, is given in Appendix G. Because of sampling problems it is extremely difficult to match samples so that they represent waste before and after treatment. Thus, it is difficult to draw conclusions. However, averaged carbon and

nitrogen data show distinct differences before and after treatment by composting (Table IV). McGauhey (McGauhey, et al., Reclamation of Municipal Refuse by Composting, University of California, Sanitary Engineering Department Technical Bulletin No. 9, Series 37, 1953) and others reported that for rapid composting the C/N ratio of refuse must not exceed 30-35. C/N ratios reported in Table IV are much higher, probably becasue of the greatly increasing content of paper and plastics in refuse today. McGauhey further reported a reduction of C/N ratios to about 20 as a result of composting the waste. On an average, the C/N ratio of Gainesville waste was reduced, but mostly when digested sewage sludge was added.

TABLE IV

AVERAGED CARBON AND NITROGEN CONTENT OF WASTE[1].

	Carbon, percent	Nitrogen, percent	C/N
Refuse Without Sludge	39.1(12)	.69(6)	56.7
Compost Without Sludge	36.9(5)	.69(5)	53.5
Refuse With Sludge	39.6(12)	.58(13)	68.3
Compost With Sludge	38.2(9)	.65(9)	58.8

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[1] Figures in parentheses indicate the number of determinations on which the average is based.

Without the addition of sludge the C/N ratio was reduced to a lesser extent. Thus, the value of sludge in enhancing waste decomposition was evidenced.

The carbon content of refuse was reduced somewhat regardless of whether the refuse was supplemented with sludge. This small reduction apparently is a reflection again of the high paper and plastics content of waste. It cannot be expected that the carbon content of either material would be detectably reduced during the short detention time in a composting digester. Thus, total carbon will not be reduced greatly.

The data show a slight increase in Kjeldahl nitrogen as sludge-supplemented refuse is composted. The increase may not be significant and thus warrants further investigation. However, one of the authors (D. T. Knuth) has observed this phenomenon in other composting processes. Furthermore, the presence of Azotobacter, a non-symbiotic nitrogen-fixing bacterium, was reported in large numbers in compost from another source (personal communication). Thus, there is evidence that nitrogen can be fixed from the atmosphere during the composting process. The significance is that this valuable nutritional element can be obtained without cost.

C. In-Plant Instrument Evaluation: Several instruments are installed in close proximity to the plant so as to facilitate the monitoring of various plant processes. The instruments include moisture and temperature sensors and a mobile instrument console described in the 1967 annual report.

The temperature sensors have worked satisfactorily but it is doubtful whether the data derived from them have been used fully for the intended purpose of process control. This is understandable inasmuch as temperature data alone are insufficient for this purpose. Temperature data must be supplemented with additional data pertaining to such parameters as moisture, aeration, nutritional state of the waste, and finally, degree of treatment attained. There is insufficient information at present to establish process control measures.

The moisture control system has never functioned properly. There are several reasons why it should not be expected to function which relate to plant operation procedures, the nature of the refuse and the design of the control system itself.

If the moisture controller is to correct the water content of the refuse to some preset level it must be able to add water (or sludge) at a rate or for a length of time which is proportional to the difference between the desired moisture content and the actual moisture content. The result is the addition of some quantity of water per percent deviation of moisture content in the refuse. This implies a constant mass flow rate of refuse past the sensor and water sprays. The mass flow rate of refuse through the system is not constant. Thus the controller should add water at a rate which is proportional to the deviation in moisture content and to the mass flow rate of refuse.

The sensing element of the moisture controller is a conductivity sensor. Conductivity measurements are based on the area of two electrodes, the distance between them, and the nature of the material between them. Refuse is a non-homogeneous material and it presents an uneven surface to the electrodes so that the area of contact between refuse and electrode changes constantly. In some cases the electrodes might even be in contact with entirely different types of material. The result is a variable signal from the sensor.

At the present time the control mechanism consists of a switch which turns on the water when the moisture content of the refuse falls below a given value and turns the water off when the moisture content rises again. Thus as the controller is now set up the rate of addition of water is not only not related to the mass flow rate of refuse, it is not even related to the deviation in the moisture content from the preselected value. Also, as currently arranged the sensing element is placed downstream from the water sprays so that there is a time delay between adjustment of moisture content and its measurement. This means that the pump sprays water on dry refuse based on information received about refuse which has already past. If we start out with dry refuse along the full length of the belt the controller will cause water to be added until the moistened refuse reaches the sensor. At this time the pump will be turned off and will remain off until more dry refuse reaches the sensor. The result will be alternating plugs of wet and dry refuse on the belt and a strip chart record consisting of high frequency maximum to minimum variations. Instrument response times are added to this transportation lag but they are probably small by comparison.

All of these problems can probably be overcome by the addition of a mass flow rate sensor and a more elaborate control system, but their solution will not be easily found.

The mobile instrument console is a potentially powerful tool for the establishment of process control. Data on oxygen uptake and carbon dioxide production by decomposing waste are vital to the determination of decomposition rates. In addition, the console can be used for the determination of temperature, dew point, and volume of air delivered to the waste. Thus far the instrument console has not been used to its full capacity. There are at least two reasons for this. First, it is impossible to drive the probes into the waste because the probe holder is too flexible. A possible solution to this problem includes the boring of a hole prior to insertion of the probe. Second, no provision was made in the construction of the instrument console for the introduction of reference gases for standardizing both the oxygen and carbon dioxide analyzers. Delays in obtaining parts to modify the gas system and to maintain the equipment have drastically reduced the effectiveness of the instrument console as of this writing.

D. Microbiological Evaluation: The microbiological evaluation is a part of the more broad program to determine the public health aspects of composting by the Metrowaste system. The rationale of this microbiological evaluation is that if certain test organisms are killed by the composting treatment, it can be assumed that other pathogens are also killed and that the product is safe for consumption. The use of test organisms as indicators of compost sanitation is a sound and practical procedure because examination for all pathogens which might inhabit compost is an extremely burdensome and impractical task, especially on a routine basis. However, selection of satisfactory test or indicator organisms is a vexing problem. Clearly, there is insufficient knowledge and experience upon which to base a judgement.

The indicator organisms used in this microbiological evaluation are the salmonellae and total and fecal coliforms. The salmonellae were selected because of their extreme public health importance resulting from their existance in food and waste and their survival in man's food chain. The coliforms were selected on the basis of their importance as indicators of water pollution from sewage sources. Part of the time during this report period digested sewage sludge was added to refuse prior to composting. This presented the opportunity to compare the effect of sludge addition on the survival of indicator organisms.

1. Methods: The procedures used were essentially those detailed in the report of progress for the period of January to April, 1968. One modification (as suggested by Dr. Fred Stutzenberger of the U.S. Public Health Service) pertains to blending of the sample with phosphate buffer prior to the determination of coliforms by the most-probable-number (MPN) method. Cold phosphate buffer was used and the blending time was reduced from 30 seconds to 15 seconds. A second modification was the use of 1 ml portions of the homogenized suspension at the start of the dilution series of the MPN procedure. These changes were made to facilitate the comparison of these data with those taken at the Johnson City composting plant.

2. Results: The daily coliform indices are given in Appendix H. The wide variation of sample size is a reflection of plant operating time, i.e. more sample was taken when the plant was operated for a full day. The results of coliform determinations are summarized in Table V. Coliforms and fecal coliforms are present in both raw ground refuse and compost, but the after-treatment MPN of both coliform classifications was less when sewage sludge was added to the refuse. This reduction of coliforms indicates that the sewage sludge may have provided missing nutrients which resulted in better waste decomposition which in turn resulted in coliform destruction. The standard deviation of total coliforms is approximately tenfold, or one logarithmic unit.

TABLE V

COLIFORM INDICES IN COMPOSITE SAMPLES

Sample Type	Dates	Number of Samples	Geometric Mean MPN/gram (Dry weight)	
			Confirmed Coliforms*	Fecal Coliforms
Raw Ground Refuse	5-27 to 6-4 7-8 to 8-28	18	1.5×10^6	4.1×10^3
Finished Compost	5-29 to 9-16	10	2.5×10^6	2.7×10^5
Raw Ground Refuse + Sewage Sludge	6-7 to 6-26	20	6.0×10^6	1.4×10^6
Finished Compost (Containing Sewage Sludge)	6-5 to 6-26	14	7.0×10^3	4.4×10^2

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*Average Standard Deviation = 1.02 logarithmic units or approximately tenfold.

A preliminary study was made to compare sampling precision (day to day variability) with analytical precision (subsamples taken from the composite sample of one given day). This was done by taking three replicate 50-gram samples of finished compost on two different days. Standard deviations of the geometric mean were ±0.7 and 1.1 or approximately tenfold. Thus, analytical variation was about the same as sample variation expected from one day to the next.

The growth of coliforms in compost was studied to determine whether pathogenic microorganisms would grow in compost if it were reinfected. In the first part of this study compost from the Gainesville plant was seeded with a broth suspension of *Escherichia coli* and the growth of this organism was subsequently determined. However, this approach was unsatisfactory because the *E. coli* suspension was immediately absorbed by the compost and thus was not uniformly distributed throughout the sample. Consequently, periodic counts of *E. coli* were very erratic.

The second part of the coliform growth study was done by periodically counting the indigenous coliform population in compost which was incubated at room temperature. Both total and fecal coliforms were counted. The numbers of total coliforms did not change during incubation from the initial population of approximately 10^6 organisms per gram. The growth of fecal coliforms was determined in a series of three tests. Table VI indicates that the numbers of fecal coliforms in two tests decreased after 48 hours. Since

TABLE VI

SURVIVAL OF FECAL COLIFORMS IN COMPOST
NUMBERS OF COLIFORMS PER GRAM OF COMPOST

Incubation Time hours	Test 1	Test 2	Test 3
0	4.0×10^6	3.2×10^6	5.0×10^5
48	5.0×10^6	3.8×10^6	1.2×10^5
72	-	4.1×10^3	4.8×10^4
96	-	-	4.0×10^4

it has been shown that the numbers of microorganisms in portions of the same sample can vary by as much as 1 logarithmic unit, it is doubtful whether the apparent die-off is significant. However, there is almost no indication that the coliforms grew in finished compost.

The recovery of microorganisms from compost by blending with buffer was studied to determine whether the length of blending has an effect on numbers of organisms recovered. Fifty-gram samples of compost were blended with 500 ml quantities of phosphate buffer in a Waring blender for 15, 30, 60 and 120 seconds. The compost suspensions were diluted and plated on Tryptone Glucose Extract Agar. The plated organisms were incubated at 35°C. Colonies were counted at 24 and 48 hours. As expected the counts were higher after 48 hours, but the length of blending time had no effect on numbers of organisms recovered.

The results of the Salmonella screening program are given in Table VII. Those isolates which produced urease are classified in the Proteus group and those which produced phenylpyruvic acid are classified in the Providence group. No isolates agglutinated Salmonella polyvalent antiserum and thus no salmonellae were found in the waste or the compost.

E. Arthropod and Rodent Control Program:

1. Rodents: Pival, an anti-coagulant rodent poison, has been used in the rat control program maintained at the compost plant. This poison has been regularly distributed as a dry bait and occasionally

TABLE VII

CHARACTERISTICS OF SALMONELLAE ISOLATES

Sample Type	Samples	Subsamples	Number of Isolates	Urea Utilizers	Phenylpyruvic acid producers	Citrate Utilizers
Raw ground refuse moistened with water	14	42	92	74	21	90
Raw ground refuse moistened with sludge	10	30	34	34	5	34
Compost with sewage sludge	10	30	131	92	34	104
Compost without sewage sludge	7	21	85	83	3	82

as a liquid bait. The baits were prepared and distributed as reported in the 1967 annual report. Rats have been observed infrequently and up to the present time do not appear to constitute a serious pest problem.

2. Roaches: A one percent Diazinon solution applied monthly (as per 1967 annual report) has given fairly effective roach control. A high roach population was observed in the receiving area during a slack period of building and sanitation maintenance. This roach population was brought under control with additional applications of Diazinon. Improved sanitary procedures were initiated to eliminate further problems in this area.

3. Flies: A considerable number of fly larvae are brought into the plant within the garbage. These larvae migrate from the garbage. If garbage is held for any length of time in the receiving area, many larvae may be observed especially along the walls of the building. This area has been sprayed monthly with Cygon, a fly larvacide, in an effort to reduce the fly population. The number of adult flies are reduced by scattering Depterex fly bait throughout the plant each day or as necessary.

During the month of June, 1968, a breakdown of proper sanitation procedures combined with an overload of moisture in the digesters resulted in the standing of septic waters in the walkways surrounding the digester tanks. These waters become breeding areas for insects associated with septic or anaerobic waters.

The following species were observed in high numbers;

Culex pipiens quinquefasciatus - Culicidae - Southern house mosquito,

Tubifera - Syrphidae - bee flies,

Hermetia - Stratiomyidae - soldier flies,

Psycoda alternata - Psycodidae - filter fly.

The conditions were pointed out to the plant operators and were satisfactorily eliminated.

F. Discussion and Plans: The technical evaluation program was modified somewhat and enlarged. This vicissitude has resulted from normal progress of the past work and from input in the form of suggestions and recommendations from outside sources. Nearly all aspects of the program were affected; the program expansion required additional personnel.

1. Sampling and Sample Preparation: As noted elsewhere in this report, the sampling procedures used in the past were not fully satisfactory. Grab samples of raw ground waste and plant effluent were taken periodically throughout each working day. Sample sizes were too small to offset errors resulting from the heterogeneity of the waste and compost. Also, there is little doubt that there was a high degree of subjectivity in taking the samples. The intention was to obtain samples which represent the entire collection of waste for a given day. An objective of the chemical analysis of samples was to determine chemical changes attributable to the composting treatment. This objective was not fully achieved since there was little apparent difference in the individual carbon and nitrogen contents of composted waste and raw waste. Data collected over a period of time and averaged did show differences in these two parameters, however.

The necessity of working with averaged data representing a considerable period of time results in a cumbersome experimental program. Conversely, it would be desirable to develop an experimental program based on sampling procedures which would show the results of composting each individual batch of waste. Because composting is known to markedly change the carbon and nitrogen content of waste, it is not clear whether the failure of the averaged data to demonstrate this was attributable to sampling and sample preparation or that the waste was poorly decomposed.

In recognition of these past shortcomings, plans were made to develop an automated system to objectively collect samples which would be representative of an entire day's input of waste. Periodically, a portion of raw ground waste will be mechanically removed from a conveyor belt leading to the digestors. These portions will be conveyed to a place away from the production facilities and stored to the end of the day. The size of waste portions to be collected periodically will be adjusted so that the daily sample will approximate 0.25% of the daily plant input. Near the end of the day the composit sample will be ground in a small hammermill, mixed, and riffled. A subsample will be further ground in a laboratory scale hammermill and then analyzed. Plant effluent will be sampled in similar fashion although construction of this sampler is expected to be relatively simple.

Subsequent to the planning of the automated sampling system, an alternative procedure was conceptualized which should greatly simplify sampling. According to the concept, a sample of raw waste ground by the production facilities will be divided into two identical portions. One portion of this sample will be prepared and analyzed immediately. The second portion will be placed in a container which in turn will be placed in the digestor where it will be composted. The container of choice appears to be a bag made of Fiberglas screen (16 mesh) having a capacity of approximately 1.5 cubic feet. After a period of composting the bag will be recovered and its contents analyzed. Differences in the analysis of samples representing waste before and after treatment should be attributable to composting, rather than to sample variation, because of greater sample uniformity. The use of this procedure will make it easier to investigate the decomposition of individual types of waste such as hospital, commercial and residential wastes. It appears that it would be more desirable to investigate composting on the basis of individual waste types rather than on the basis of a mixture of wastes collected throughout a given day, as was done in the past. In addition, the container procedure will facilitate the study of composting under a much wider variety of conditions than is practical or even possible at present. Parameters such as moisture, aeration, agitation and pH can be varied readily on a small scale and their effects more readily observed through the use of the container procedure. For example, in a study of the effect of aeration on waste decomposition, it is possible to attain a wide range of aeration rates in small containers within the digestor. It may be impractical to experimentally vary the aeration of an entire digestor or even a section with a digestor.

The laboratory is about to acquire a grinder which will be used to grind samples prior to all chemical analyses except moisture and perhaps prior to microbiological analyses also. It is expected that fine grinding will enhance analytical precision. In the past, samples were ground dry in a Waring blender--a procedure which proved to be unsatisfactory. The new grinder is known as a Mikro Samplmill and is available from Pulverizing Machinery Division, Summit, New Jersey. It is in effect a small hammermill. As such, it has certain inherent advantages over cutting type mills which are subject to excessive blade wear and damage when solid waste is ground. A Mikro Samplmill was made available to test its suitability for grinding compost. A milled sample was divided into six portions which were analyzed for carbon by combustion. The average carbon content was 36% and the standard deviation was slightly less than 1%. These data compare very favorably with those of the past when samples were ground dry in a Waring blender. Under those conditions standard deviations were in the range of 5-10%.

2. Chemical Analyses: Analysis of raw waste and compost for carbon, nitrogen, phosphate, and potassium, as well as moisture and hydrogen ion concentration (pH), will continue. Experience has shown the desirability of standardizing these procedures through the analysis of compounds having known composition.

3. In-Plant Instrumentation: It has become apparent that it would be desirable to have one technician assigned exclusively to the in-plant instrumentation. This is indicated by the complexity of the equipment,

its specialized nature and the desirability of obtaining maximum utilization of the equipment. It is not implied that this instrumentation in a production plant would require full-time attention. However, this amount of attention is desirable for the technical evaluation.

Recently a qualified electronics technician was hired to work almost full-time with the instrument console and the moisture and temperature detectors. Thus, it is expected that the instrument capabilities can be more fully evaluated and applied.

4. Microbiological Analyses: Several changes in the microbiological program were designed to better elucidate the public health aspects of compost and the composting process. One of the most important objectives of the microbiological program is to demonstrate that the Metro composting process destroys all organisms which might be detrimental to public health. To directly demonstrate the absence in compost of every pathogenic organism is extremely cumbersome and impractical. A procedure patterned after one used in the examination of waters receiving sewage effluents was employed here. In that procedure the presence of indicator organisms in a sample is taken as presumptive evidence that other pathogens of fecal origin are also present. In the examination of receiving waters the coliform group of bacteria is used as an indicator because it has been shown that this group always accompanies fecal contamination, and relative to other intestinal pathogens they are easy to detect.

The indicators used in this evaluation are total coliforms, fecal coliforms and the salmonellae group. They were selected somewhat arbitrarily because there are no organisms known to be satisfactory indicators of compost hygienicity. The indicators might be indigenously present in untreated waste. The procedure is to assay samples of waste before and after composting. An assumption which is presently being made is that if these indigenous indicators cannot be found in compost samples collected during any given day, the compost produced that day is free of pathogens. The converse is true, but under practical conditions failure to detect indicators does not mean that the compost is pathogen free. The indicators and other pathogens may be present at low levels or they may be scattered non-uniformly, thus making their detection difficult or impossible.

Two alternative procedures for the selection of indicator organisms and methods for demonstrating compost hygienicity are planned. In one method, raw ground waste will be contained within a small bag made of Fiberglas screen (16 mesh) and seeded with a known number of the test microorganisms. The bag will then be placed along with other waste in the digestor. After the normal composting period the bag will be removed from test and assayed for the seeded organism. Presence of test organisms in the sample will indicate, like the presently used procedure, that the composting process did not sanitize the waste. Failure to detect the test organism, however, will indicate positive kill because the test organism will have been known to be present in that particular sample prior to composting. The bag procedure will nearly eliminate the uncertainty of random or systematic sampling procedures which depend upon chance. Also, because the bag sampling procedures which depend upon chance. Also, because the bag procedure eliminates the necessity of collecting numerous samples each day, it could be developed into a convenient routine test.

In the second method, the waste will be composted in a laboratory fermentor where environmental conditions can be carefully observed. The rate of microbial die-off will be studied as a function of treatment time, temperature, aeration, etc. A number of candidate organisms, selected on the basis of their known presence in refuse, will be ranked according to their resistance to death in a composting environment. Some of the more resistant organisms would then be subjected to practical but carefully monitored conditions which exist during composting on a production scale. When completed, this study is expected to define the practical operating conditions which produce a compost free of harmful organisms. Investigations of this type will provide an experimental basis for selecting indicator organisms and a practical method for demonstrating a safe plant effluent.

This type of experimental approach was endorsed by the Florida Air and Water Pollution Control Commission. Similarly, the Florida State Board of Health agreed to reduce their requirement for daily pathogen sampling to twice-a-week sampling. They further agreed to discontinue their requirement for total coliform analyses. The time saved by this program reduction will be devoted to developing a better method for demonstrating compost sanitation.

The public health aspects of handling solid wastes will be further investigated through a program to determine the hazards of airborne particles to workers. The hazards exist wherever dust is formed. Dust generating areas include the refuse receiving ramp, the hammermills, and the effluent conveyors. Airborne particles include viable particles such as spores and cells of microorganisms, and non-viable particles such as dust and pollen. Air will be sampled for airborne particles near these sources and other places to delineate safe and hazardous areas. The effects of atmospheric conditions on the suspension of particles will also be determined.

The Andersen Sampler will be used for these purposes. When modified to detect viable particles, the Sampler separates microorganisms into six categories according to size and aerodynamic properties. The microorganisms are deposited on the surfaces of agar contained in six Petri dishes. The use of various types of agar determines the types of microorganisms which can be detected. Similarly, the Andersen Sampler separates non-viable particles into six categories. These particles are deposited on collection plates which are examined microscopically. Particles less than 5 microns in diameter are known to penetrate the lungs and are thus hazardous.

5. Pest Control Program: Prominent among the problems to be faced are those resulting from high fly populations. Studies are to be initiated to trace the movement of flies about the plant and to and from the surrounding neighborhoods.

An investigation to determine the thermal death point of flies will also be undertaken to determine if the heat generated within the compost is sufficient to kill all developmental stages of houseflies. An Atkins electronic thermometer was bought for this purpose. Studies to determine seasonal variation in number, sex, and species will also be undertaken.

6. Development of Methods for the Determination of Compost Maturity: Several methods for the determination of compost maturity or stability will be evaluated for applicability, and one will be developed for routine use. The extent of treatment of sewage and other liquid wastes is determined by reduction of biochemical oxygen demand (BOD), chemical oxygen demand (COD), solids content and other criteria. No such quantitative and objective criteria exist for solid wastes. A good method would be highly desirable for use in this demonstration project because it could be used for the determination of extent of treatment attained by the process. Furthermore, the method could become the basis on which the effectiveness of various operating parameters are judged. The establishment of optimal operating conditions could then become the basis for the design of new composting plants.

   As discussed in the Chemical Evaluation Section (Section B), Gainesville waste is very high in carbon content as compared with earlier reports by others. This is a reflection of a greatly increased content of paper and plastics which decompose only slightly during composting in the digester. It was also pointed out in Section B that the nitrogen content of waste apparently increased during the composting of waste supplemented with sludge. The extremely high content of non-decomposable carbon and the variable content of nitrogen strongly show the inadequacy of a decreasing C/N ratio for the determination of degree of compost treatment. The desirability of a method for the determination of biologically available carbon is clearly indicated.

Some unpublished data indicate that the BOD test with some modification can be used for the determination of compost stability. However, slight errors in dilution ratios result in very large differences in oxygen demands, which are manifested in poor experimental precision. However, the advantage of the BOD test is that it is a measure of the carbon which is available for biological utilization. This is important because composting is a biological degradation process. Consequently, the BOD value of raw solid waste is an approximation of the carbon which could be decomposed by composting. Also, the BOD value of composted waste is an approximation of further decomposition potential. It is this decomposition potential which leads to odors when an immature compost becomes wet. The difference between BOD values before and after composting is a measure of what was accomplished during composting.

There are several possible solutions to the poor experimental precision which is typical of the BOD test modified for solid waste. One solution is to treat the waste as a solid and thereby avoid dilution errors. It would be possible to determine the oxygen consumption of the decomposing test sample either menometrically or instrumentally. Examples of parameters which will be investigated include sample size, incubation duration, and temperature and seeding requirements. It is expected that a quantitative method for the determination of solid waste stability would have application as a research tool and a quality control test for most solid waste treatment methods.

G. Project Staffing and Work Tasks: The major staffing change of the expanded program is the inclusion of key personnel who devote nearly full-time to the project. In the past nearly all personnel were part-time employees who worked only a fraction of their time on this project. The project staffing is as follows:

1. Technical Supervisor (David T. Knuth). His responsibilities include supervision, planning, data evaluation and reporting. He is spending approximately 30 hours per week at these tasks.

2. Microbiological technician. His duties include routine coliform and salmonellae screening, air sampling and pathogen destruction studies. He devotes 40 hours per week.

3. Chemical technician. His duties include the analysis of refuse and compost for carbon, nitrogen, phosphorus and potassium. He will be assisted when necessary by the electronics technician. He works 16 hours per week at these tasks and is a student in Chemical Engineering.

4. **Electronics technician**. He operates and maintains the in-plant instrumentation including the instrumental cart. He is a part-time student in Forestry but works full-time.

5. **Additional personnel**. A chemist and a microbiologist serve as consultants to the project. They devote 1-2 hours per week. An entomologist is studying an aspect of composting as his thesis project. He also carries out the pest control program at the plant.

H. **Summary**: The technical evaluation program has shown that the addition of digested sewage sludge to refuse and garbage tripled the extent of waste degradation as determined by C/N ratio reductions. Also, the addition of sludge greatly reduced the coliform content of compost. Coliform populations remained stationary during the composting of refuse which received no sewage supplement. Coliform populations were reduced 3-4 orders of magnitude when sludge supplemented waste was composted. Thus, these chemical and microbiological criteria indicate that the addition of sludge is highly desirable.

That the digestion process could be improved is indicated by a smaller reduction of C/N ratios as a result of composting than those reported in the literature. Visual examination of Gainesville compost prior to final grinding indicates only moderate waste degradation. Although no salmonellae were found in compost samples, Public Health Service investigators found living parasites in one sample of Gainesville compost, indicating something less than good treatment.

Digestion probably could be improved by maximizing the moisture content of the waste, grinding it more finely and by increasing the extent of aeration and agitation. If the uncured compost were used for agricultural purposes it probably would have deleterious effects on plants.

Methods were developed for the analysis of refuse and compost for phosphorus and potassium. Some recommended procedures for these analyses were unsatisfactory.

Improving the composting process depends strongly on the development of a satisfactory method for the determination of compost maturity. The deficiency of the C/N ratio for this purpose was discussed. The advantages of a method for the determination of biologically available carbon were also discussed.

The necessity of fine grinding of refuse and compost prior to chemical analysis was clearly demonstrated. A type of laboratory hammermill was satisfactory for this purpose, but the waste must be fairly fine before it can be fed into the mill.

The sampling of waste for chemical analysis was only moderately satisfactory. It was necessary to average C/N ratio data before differences resulting from composting were apparent. Data representing individual batches of waste were inconclusive partially because of sampling errors. A new technique is being evaluated to determine if it can circumvent sampling problems. The technique includes the analysis of identical samples representing waste before and after treatment.

APPENDIX A

TONS OF REFUSE RECEIVED MAY

Date	City		County		University		Total	
	Trucks	Tons	Trucks	Tons	Trucks	Tons	Trucks	Tons
5- 1-68	48	137.4	4	4.8			52	142.2
2	11	22.1	6	8.1			17	30.2
3	14	32.8	7	9.1			21	41.9
SUB.	73	192.3	17	22.0			90	214.3
5- 6-68								
7								
8								
9	28	84.7	6	8.5			34	93.2
10	32	93.0	7	9.5	1	9.9	40	112.4
11	17	60.7					17	60.7
SUB.	77	238.4	13	18.0	1	9.9	91	266.3
5-13-68	39	159.3	7	12.6			46	171.9
14	33	128.3	8	19.6			41	147.9
15	41	137.9	5	8.0			46	145.9
16	29	93.4	6	13.4			35	106.8
17	31	96.7	7	7.9			38	104.6
18	11	33.2					11	33.2
SUB.	184	648.8	33	61.5			217	710.3
5-20-68	32	109.5	9	19.9			41	129.4
21	37	119.5	9	18.1			46	137.6
22	41	126.9	6	8.3			47	135.2
23	31	88.9	8	14.4			39	103.3
24	33	97.9	8	13.6			41	111.5
25	8	23.9					8	23.9
SUB.	182	566.6	40	74.3			222	640.9
5-27-68	36	131.7	9	19.7			45	151.4
28	24	100.6	8	18.0			32	118.6
29	41	181.6	3	8.1			44	189.7
30	(Holiday)							
31	39	133.4	13	23.5			52	156.9
SUB.	140	547.3	33	69.3			173	616.6
TOTAL	656	2,193.4	136	245.1	1	9.9	793	2,448.4

TONS OF REFUSE RECEIVED JUNE

Date	City		County		University		Total	
	Trucks	Tons	Trucks	Tons	Trucks	Tons	Trucks	Tons
6- 1-68	26	96.0					26	96.0
SUB.	26	96.0					26	96.0
6- 3-68	33	110.4	8	19.5	1	10.8	42	140.7
4	28	104.0	7	15.3	1	12.7	36	132.0
5	41	144.8	4	5.6	1	13.6	46	164.0
6	8	28.5	4	6.2	1	16.2	13	50.9
7	32	156.2	8	22.1	2	23.7	42	202.0
8	24	119.3	1	4.3	1	18.4	26	142.0
SUB.	166	663.2	32	73.0	7	95.4	205	831.6
6-10-68			7	15.2	1	14.9	8	30.1
11	33	128.9	8	21.0	3	29.2	44	179.1
12	44	148.3	4	6.3	2	21.5	50	176.1
13	33	127.1	8	16.1	1	12.9	42	156.1
14	29	118.8	8	23.1	1	13.0	38	154.9
15	19	63.9			1	11.6	20	75.5
SUB.	158	587.0	35	81.7	9	103.1	202	771.8
6-17-68	30	126.5	7	18.1	2	16.0	39	160.6
18	28	118.3	8	19.5	1	11.5	37	149.3
19	37	138.2	6	8.0	1	11.2	44	157.4
20	24	101.9	7	18.6	1	12.8	32	133.3
21	27	118.0	7	15.9	3	16.5	37	150.4
SUB.	146	602.9	35	80.1	8	68.0	189	751.0
	(Down for Centriblast Modifications)							
SUB.								
TOTAL	496	1,949.1	102	234.8	24	266.5	622	2,450.4

APPENDIX A

TONS OF REFUSE RECEIVED JULY

Date	City		County		University		Total	
	Trucks	Tons	Trucks	Tons	Trucks	Tons	Trucks	Tons
7- 1-68								
2	31	133.3	4	12.1	1	13.3	36	158.7
3	9	26.4	2	2.7	3	33.7	14	62.8
4	(Holiday)							
5	30	135.1	4	10.7	1	11.3	35	157.1
6	22	113.6					22	113.6
SUB.	92	408.4	10	25.5	5	58.3	107	492.2
7- 8-68	27	117.6	3	10.0			30	127.6
9	27	107.6	5	14.9	2	26.4	34	148.9
10	9	41.9	3	6.0			12	47.9
11	22	110.9	6	17.2	1	16.5	29	144.6
12	26	127.2	5	14.7	1	11.9	32	153.8
13	5	15.4			1	12.3	6	27.7
SUB.	116	520.6	22	62.8	5	67.1	143	650.5
7-15-68	32	126.4	6	18.6	1	14.6	39	159.6
16	35	144.3	5	19.5	1	12.1	41	175.9
17								
18	(Took no refuse - preparing for plant shut down)							
19								
SUB.	67	270.7	11	38.1	2	26.7	80	335.5
	(Plant Closed)							
SUB.								
	(Plant Closed)							
SUB.								
TOTAL	275	1,199.7	43	126.4	12	152.1	330	1,478.2

APPENDIX A

TONS OF REFUSE RECEIVED AUGUST

Date	City		County		University		Total	
	Trucks	Tons	Trucks	Tons	Trucks	Tons	Trucks	Tons
	(Plant Closed)							
SUB.								
	(Plant Closed)							
SUB.								
	(Plant Closed)							
SUB.								
	(Plant Closed)							
SUB.								
8-26-68								
27	13	34.1	4	10.6	2	14.1	19	58.8
28	10	41.9	2	3.9	1	8.0	13	53.8
29	9	35.6	2	6.7	1	10.3	12	52.6
30	18	75.5	4	9.3	1	13.7	23	98.5
31	7	27.4	1	1.9			8	29.3
SUB.	57	214.5	13	32.4	5	46.1	75	293.0
TOTAL	57	214.5	13	32.4	5	46.1	75	293.0

Processing and Salvage Chart - MAY

BLOCK A - PROCESSING

Batch No. ______	TODAY	TOTAL THIS MONTH	22 DAY AVERAGE
No. of Trucks Received: City 656			
County 136			
Univer. 1			
TOTAL		793	36
Tons of Refuse Received: City 2,193.4			
County 245.1			
Univer. 9.9			
TOTAL		2,448.4	111.3
Hours Primary Grinder Ran		136.8	6.5
Hours Secondary Grinder Ran			
Tons per Hour Ground			17.9
Gallons of Sludge Added			
Paper Bales - NEWS			
Paper Bales - CORRUGATED			
Paper Bales - MIXED 895# per bale		247	11.8
Rag Bales			
Tons of Steel Scrap		10.3	
Tons of Tin Cans		99.0	
Tons of Non-Compostables		182.5	

BLOCK B - FINISHING

Batch No. ______	TODAY	THIS MONTH	___DAY AVERAGE
Hours Regrinders Ran		242	11
Tons of Bulk Compost		1,022	46.45

SALVAGE TABLE

ITEM	TONNAGE	PERCENTAGE	VALUE
Paper	103.8	4.2	$1624.20 *
Tin Cans	99.0	4.0	--------
Scrap Iron	10.3	.5	--------
Non-Compostables	182.5	7.4	--------
Compostables	2,052.8	83.9	--------
TOTALS	2,448.4	100.0	$1,624.20

GENERAL NOTES:

* This represents 70.2 tons at $15.00 per ton and 33.6 tons at 17.00 per ton.

No market for tin cans at present.

APPENDIX B

Processing and Salvage Chart - JUNE

BLOCK A - PROCESSING

Batch No. ______	TODAY	TOTAL THIS MONTH	19 DAY AVERAGE
No. of Trucks Received: City 496			
County 102			
Univer. 24			
TOTAL		622	28.3
Tons of Refuse Received: City 1,949.1			
County 234.8			
Univer 266.5			
TOTAL		2,450.4	128.9
Hours Primary Grinder Ran		144.2	7.6
Hours Secondary Grinder Ran		205.0	10.8
Tons per Hour Ground			17
Gallons of Sludge Added		189,173	9,956
Paper Bales - NEWS			
Paper Bales - CORRUGATED			
Paper Bales - MIXED 900# per bale		149	7.8
Rag Bales			
Tons of Steel Scrap			
Tons of Tin Cans		114.8	6
Tons of Non-Compostables		358.5	18.8

BLOCK B - FINISHING

Batch No. ______	TODAY	THIS MONTH	26 DAY AVERAGE
Hours Regrinders Ran		319.7	12.2
Tons of Bulk Compost		2,593.5	99.8

SALVAGE TABLE			
ITEM	TONNAGE	PERCENTAGE	VALUE
Paper	67.0	2.7	$1,139.00
Tin Cans	114.8	4.7	--------
Scrap Iron	------		
Non-Compostables	358.5	14.6 *	--------
Compostables	1,909.5	78.0	--------
TOTALS	2,450.4	100.0	$1,139.00

GENERAL NOTES:

* High percentage of non-compostables due to large quantities of trash the city brings into the plant which we cannot process.

APPENDIX B

Processing and Salvage Chart - JULY

BLOCK A - PROCESSING

Batch No. ______	TODAY	TOTAL THIS MONTH	12 DAY AVERAGE
No. of Trucks Received: City 275			
County 43			
Univer. 12			
TOTAL		330	27.5
Tons of Refuse Received: City 1,199.7			
County 126.4			
Univer 152.1			
TOTAL		1,478.2	123.2
Hours Primary Grinder Ran		71.4	5.9
Hours Secondary Grinder Ran		94.5	7.8
Tons per Hour Ground			20.7
Gallons of Sludge Added		-----	
Paper Bales - NEWS			
Paper Bales - CORRUGATED			
Paper Bales - MIXED 925# per bale		105	8.7
Rag Bales			
Tons of Steel Scrap			
Tons of Tin Cans		48.1	4
Tons of Non-Compostables		134	11.2

BLOCK B - FINISHING

Batch [illegible] ______	TODAY	THIS MONTH	16 DAY AVERAGE
Hours Regrinders Ran		166	10.3
Tons of Bulk Compost		837.7	52.3

SALVAGE TABLE

ITEM	TONNAGE	PERCENTAGE	VALUE
Paper	48.6	3.3	$923.40 *
Tin Cans	48.1	3.3	-------
Scrap Iron			
Non-Compostables	134	9.2	--------
Compostables	1,247.5	84.2	--------
TOTALS	1,478.2	100.0	$923.40

GENERAL NOTES:

* This represents an increase in paper prices from $17.00 per ton to $19.00 per ton.

Low quantities due to plant closing July 19th.

APPENDIX B

Processing and Salvage Chart - AUGUST

BLOCK A - PROCESSING

Batch No. ________	TODAY	TOTAL THIS MONTH	5 DAY AVERAGE
No. of Trucks Received: City 57			
County 13			
Univer. 5			
TOTAL		75	15
Tons of Refuse Received: City 214.5			
County 32.4			
Univer. 46.1			
TOTAL		293	58.6
Hours Primary Grinder Ran		13.2	2.6
Hours Secondary Grinder Ran		15.4	3
Tons per Hour Ground			22.2
Gallons of Sludge Added		----	
Paper Sales - NEWS			
Paper Sales - CORRUGATED			
Paper Sales - MIXED 914# per bale		14	2.8
Rag Sales			
Tons of Steel Scrap			
Tons of Tin Cans		5.9	1.2
Tons of Non-Compostables		19.8	4

BLOCK B - FINISHING

Batch No. ________	TODAY	THIS MONTH	10 DAY AVERAGE
Hours Regrinders Ran			
Tons of Bulk Compost			

SALVAGE TABLE

ITEM	TONNAGE	PERCENTAGE	VALUE
Paper	6.4	2.2	$41.80
Tin Cans	5.9	2	-------
Scrap Iron			
Non-Compostables	19.8	6.7	-------
Compostables	260.9	89.1	-------
TOTALS	293	100.0	$41.80

GENERAL NOTES:

Low quantities due to plant being closed until August 27th.

APPENDIX B

APPENDIX C

COMPOST PRODUCED
AND DISTRIBUTION IN TONS

MONTH	COMPOSTABLES IN	COMPOST OUT *	SALES	CONTRIBUTIONS			TOTAL DIST.
				CITY	COUNTY	UNIVER.	
MAY	2,052.3	1,022.0	7.6	19.9			27.5
JUNE	1,909.5	2,593.5		81.7		57.3	139.0
JULY	1,247.5	837.7 **	323.7			101.9	425.6
AUGUST	260.9	269.1 **				8.1	8.1
TOTALS	5,470.2	4,722.3	331.3	101.6		167.3	600.2

* When material comes out of the Regrinders it is stocked in a pile at the end of the bulk storage belt. Compost out indicates that it has been moved from this conveyor location to a permanent stock pile until sold. The amount of material actually moved is estimated on the basis of the number of buckets full of compost at an average weight of 2,000# or 1 ton per bucket.

** The low figures in July and August were due to the plant closing from July 19th until August 27th.

CALORIFIC VALUE OF A SAMPLE
FROM THE GAINESVILLE COMPOST PLANT

A. Sampling Date: May 2, 1968

B. Sample: A single undried "grab" sample of reject material (consisting of ground paper, plastics, and other light materials) was examined.

C. Sample Preparation: A Wiley Mill was used to reduce the sample to particles that could pass through a sieve with 2 m. m. apertures. The ground sample was then analyzed without drying or additional preparation other than thorough mixing.

D. Sample Analysis: The calorific value was determined using a Parr Adiabatic Calorimeter, using procedures as discussed in the Parr Manual. The standardization (energy equivalent factor) was established using the primary standard benzoic acid.

E. Results:

Type of Sample	Determination Number	Sample Weight (Grams)	Calorific Value (Cal. / Gram)
Reject Material	1	0.9245	2992
	2	1.0010	2903
	3	0.9111	3014

The average calorific value of the "reject material" was found to be 2969 calories per gram, using an average energy equivalent factor of 1385 cal. / degrees F.

F. Conclusion: When burned, each pound of undried "reject material" will generate 5,344 B T U.

APPENDIX E

PROPOSAL
CENTRIBLAST CORPORATION
A Subsidiary of Joy Manufacturing Co.

No. 168-A Page No. 1

To Metropolitan Waste Conversion
108 West Liberty Drive
Wheaton, Illinois

From F. Josenhans, General Manager
Centriblast Corporation
November 21, 1966

Gentlemen:

We propose to furnish you, and deliver F. O. B., Factory - Crusher Disintegrator as described below.

on terms and conditions named below, the machinery (hereinafter called property) described as follows or in the specifications hereto attached and made a part of this proposal.

MACHINERY:

Model:	One CDM-4824-HD Crusher Disintegrator complete with heavy duty frame and overload design.
Tracks:	Metal: Speeds - 40 fpm top and bottom. Upper track to be overload suspension type.
Disintegrator:	Impact type with self-hardening, high-strength impacters and standard anvil wheel orientation (patent pending).
Drive:	Motors starters and controls are included. Wiring of the disintegrator motor and controls in the field is not included. Disintegrator motor 300 h.p. 3 ph/60 cycle 440 Volt dripproof construction and dustproof starter (across-the-line). Track motors and starters: Two 7½ h.p. 3 ph/60 cycle 220/440 Volt Motors are dripproof - Starters are dustproof.
Finish:	Centriblast standard gray enamel.
Backup Screen:	Not included.

- continued -

DESIGN DETAILS:

Provision will be made in the design for the following:

1. Ability to run without operating problems being caused by wrapping of cloth about the disintegrator or star shafts.
2. Ability to clean out areas when material may collect and consideration of the desire to have any collection points minimized.
3. Provision for collecting drippage from converging tracks.
4. A wiping plate, probably rubber,to reduce carry-back of material around the lower track.
5. Material discharge to the rear with the lower deflection plate being adjustable to provide zero to the maximum practical upward deflection (with a target of 30°) of disintegrated material. Consideration will also be given to having this as the entry door for replacement of the hammers.
6. Legs will be arranged to give a ten degree rise to the rear of the unit.
7. Hammers will be removable type.
8. Motors are included as shown above. Should the electrical specifications be changed, any change in our cost on this equipment will be a change (either up or down) to your account.

- continued -

Conditions:

Special Warranty:

✓ (a) When fed the full normal range of municipal solid waste disposal materials, all at an average mix of 70% paper and cardboard, and the balance other materials all at an average of 25-30% moisture content, with the exclusion of large and heavy items such as electrical motors, large tree limbs, etc., all being fed at a reasonably steady rate of about 40 fpm at an average height of 4", the CDM-4824-HD will reduce this mixture to an average particle size of approximately six sq. inches at a rate of 40,000 lbs. per hour.

(b) Materials specifically not covered by the above warranty:

1. Appliances, stoves or stove parts and furniture.
2. Any crushable and disintegratable piece exceeding 36" wide x 30"high at in-feed.
3. Any metal piece in excess of 1/16" thick and 36" wide.
4. Rubber tires or similar heavy rubber sections.

It should be understood that the impacter and other component wear is proportional to the hardness and abrasiveness of the material being processed. For this reason it may be in the purchaser's interest to avoid processing such materials even though the machine has the capacity to reduce it, especially to minimize the frequency of hard surfacing.

It is further understood that the purchaser will be responsible for the provision of adequate safety measures to prevent personal injury of property damage including provision for safe handling.

This Special Warranty will be considered as having been met if no claim is made within six months under the Standard Warranty and within 15 days after startup (or 60 days after shipment, whichever date comes first) under the Special Warranty.

In the event of failure of the equipment to meet the warranty, Centriblast must be notified in writing and be allowed 30 days after receipt of notification to supply parts, make modifications or otherwise bring the performance to that of warranted. In such case, the Purchaser agrees to supply the labor for such work at his expense, Centriblast to supply parts and engineering supervision of the work done. If, after 15 days of operation following modifications, Centriblast has not been able to meet the conditions it warrants, the Purchaser will have the option to return the equipment to the Centriblast Factory paying equipment removal and freight charges.

Upon receipt of the equipment in the Centriblast factory in a condition equal to that at the time it was removed, Centriblast will refund the full purchase price paid. Such refund will release Centriblast from all further obligations to the Purchaser.

No other Warranty is made except as herein stated, and in no even or under any conditions will Centriblast be held or deemed liable for any special, indirect, consequential or contingent liabilities or damages.

PROPOSAL

CENTRIBLAST CORPORATION
A Subsidiary of Joy Manufacturing Co.

No. 168-A **Page No.** 4

ERECTING ENGINEER or DEMONSTRATOR (not included unless expressly stated). - Price includes services (including travel and living expenses) of a start-up engineer for 3 days at your plant. Additional time, if requested, will be chgd. at std. rates.

SHIPMENT: Shipment to be made in
Best possible time with target date of April 21,1966.

PRICE: The price of said property delivered as above, and subject to the conditions herein stated, is $68,500.00

CONDITIONS: Seller shall not be liable in any way for delay, nondelivery, or default in shipment due to labor disputes, transportation shortage, priorities, acts of governmental authorities and all other causes beyond the control of Seller, affecting Seller and/or its suppliers.

Unless otherwise stated herein, Seller will repair or replace, without charge f. o. b. point of shipment, any parts of its own manufacture proven upon Seller's examination to be defective in material or workmanship when furnished, provided claim is made within six months after date of shipment. Deterioration or wear occasioned by chemical or abrasive action or excessive heat shall not constitute defects. At the request and at the sole cost of Buyer, Seller will supply labor to replace any such defective part. Equipment and accessories not of the Seller's manufacture are warranted only to the extent that they are warranted by the manufacturers. THERE ARE NO OTHER WARRANTIES, EXPRESS, STATUTORY OR IMPLIED, INCLUDING THAT OF MERCHANTABILITY AND OF FITNESS.

No liability for any special, indirect or consequential damages of any nature is assumed by or shall be imposed on Seller based on its undertakings herein.

If under any law or governmental regulation now or hereafter in effect, the seller is required to pay or collect any tax upon the property included in this order or predicated upon, measured by or arising from the sale, transportation, delivery, use or consumption of said property, directly or indirectly, the price to be paid by the buyer hereunder shall be increased by the amount of any such tax which the buyer agrees to pay as part of the purchase price.

TERMS OF PAYMENT: 25% paid with order
65% at time of shipment
10% - upon meeting performance warranty. This will be checked by Metropolitan Waste within 60 days of delivery and if there is any question of meeting same, Metropolitan will demonstrate this deficiency to representatives of Centriblast within fifteen days.

(Payable in New York or Chicago Exchange, free of expense to us for collection charges)

TITLE: The title and ownership of all property furnished hereunder, wherever situated and whatever the method or mode of attachment if any to realty, shall remain in the Seller until full and final payment in cash has been made in accordance with the provisions hereof, and all other conditions have been fully performed.

The property is to be kept on the premises of the Buyer at or near.. County.............................. State.

The buyer may not remove the property from the County or State without the written consent of the Seller. When all payments have been made and all conditions performed as herein provided, title shall pass to the Buyer.

Upon default by the Buyer in performance of any of the terms hereof, the Seller, without notice or legal demand and with or without legal process, shall have the right to take immediate possession of said property wherever it may be found. To that end the Seller shall have the right to enter into any premises where the property may be located, using reasonable force if necessary, without incurring any liability for damages for such entry. In the event of such repossession by reason of any such default, the Seller may retain any and all payments previously made, not by way of penalty but as liquidated damages and as consideration for rent and use.

INSURANCE: Insurance is to be taken out and maintained by the Buyer in an amount sufficient to fully protect the Seller's interest in the property, the policies of insurance to be made payable to the Seller, as its interests may appear at time of loss and the policies are to be delivered to Seller to be held as collateral security.

Any portion of this contract found to be contrary to the law of any State or jurisdiction shall be considered as severable therefrom, and its inclusion herein shall not be construed to invalidate the remaining portions.

This proposal is for immediate acceptance only, but although accepted it shall not constitute a contract until approved by an officer of the Seller at its main office in Pittsburgh, Pennsylvania, and subject to change or withdrawal until so approved. It is expressly agreed that there are no premises, agreements, or understandings outside of this contract, that no agent or salesman has any authority to obligate the Seller by any terms, obligations, or conditions not herein expressed. This contract, when accepted, is not subject to cancellation and may be altered only by the written consent of both parties hereto.

Customer's Signature

....

By ....

Title ....

Dated ....

CENTRIBLAST CORPORATION

By ....
(For the Company)

Approved by Centriblast Corporation

By ....

Title ....

Date Approved ....

APPENDIX F

OPERATING COST PER TON OF REFUSE PROCESSED

MONTH OF MAY

EQUIPMENT	MAINT.	MAINT. LABOR	REPAIRS	REPAIR LABOR	ELECTRIC	TOTAL COST	TONS PRO-CESSED	COST PER TON
Primary Grinder (CENTRIBLAST)	$ 151.42	$ 855.17	$ 388.81	$ 240.61	$ 217.00	1,853.01	2,151	$ .86
Secondary Grinder (WILLIAMS)	338.78	1,054.52	67.93	461.58	415.00	2,337.81	2,151	1.08
TRIPPER	4.20	327.06	665.48	217.75	5.00	1,219.49	2,052	.59
AGI-LOADER		550.51	48.95	91.97	25.00	716.43	1,022	.70
FINISHING EQUIP. (Refer to sec. 1V for explanation)	1,006.29	1,601.55	128.01	112.15	333.00	3,181.00	1,022	3.11

* *

MONTH OF JUNE

Primary Grinder (Centriblast)	255.96	773.83	206.90	786.76	203.00	2,226.45	2,024	1.10
Secondary Grinder (Williams)	297.56	1,441.11	570.70	38.67	391.00	2,739.04	2,024	1.35
TRIPPER		391.32	254.65		4.00	649.97	1,910	.34
AGI-LOADER	42.00	705.03	45.44	28.87	29.00	850.34	2,593	.32
FINISHING EQUIP.	553.85	1,194.58	897.77	486.74	389.00	3,521.94	2,593	1.35

APPENDIX F

OPERATING COST PER TON OF REFUSE PROCESSED

MONTH OF JULY

EQUIPMENT	MAINT.	MAINT. LABOR	REPAIRS	REPAIR LABOR	ELECTRIC	TOTAL COST	TONS PROCESSED	COST PER TON
Primary Grinder (CENTRIBLAST)	14.63	134.86	288.29	342.21	109.00	888.99	1,296	$ .68
Secondary Grinder (Williams)	290.58	718.12			207.00	1,215.70	1,296	.94
TRIPPER		176.67		8.68	2.00	187.35	1,248	.15
AGI-LOADER	9.16	368.46	43.71	25.55	16.00	462.88	838	.55
FINISHING EQUIP.	287.65	1,068.89	484.86	54.25	220.00	2,115.65	838	2.52

* *

MONTH OF AUGUST

EQUIPMENT	MAINT.	MAINT. LABOR	REPAIRS	REPAIR LABOR	ELECTRIC	TOTAL COST	TONS PROCESSED	COST PER TON
Primary Grinder (CENTRIBLAST)	28.09	173.18			30.00	231.27	267	.86
Secondary Grinder (WILLIAMS)	17.08	91.68			58.00	166.76	267	.62
TRIPPER	61.20	38.90	29.51		1.00	130.61	261	.50
AGI-LOADER		95.79		14.40	7.00	117.19	269	.43
FINISHING EQUIP.	119.98	291.06	5.34		91.00	507.38	269	1.88

OPERATING COST PER TON
OF REFUSE PROCESSED

APPENDIX F

~~MONTH OF~~ TOTALS - 4 Month Period

EQUIPMENT	MAINT.	MAINT. LABOR	REPAIRS	REPAIR LABOR	ELECTRIC	TOTAL COST	TONS PROCESSED	COST PER TON
Primary Grinder (CENTRIBLAST)	450.10	1,937.04	884.00	1,369.58	559.00	5,199.72	5,738	$ .90
Secondary Grinder (WILLIAMS)	944.00	3,305.43	638.63	500.25	1,071.00	6,459.31	5,738	1.12
TRIPPER	65.40	933.95	949.64	226.43	12.00	2,187.42	5,471	.40
AGI-LOADER	51.16	1,719.79	138.10	160.79	77.00	2,146.84	4,722	.45
FINISHING EQUIP.	1,967.77	4,156.08	1,515.98	653.14	1,033.00	9,325.97	4,722	1.98

APPENDIX G

SUMMARY OF CHEMICAL ANALYSES

pling	Ground Refuse					Final Ground Compost				
Date	Sludge Added	% H_2O	% N	% C	C:N	Sludge Added	% H_2O	% N	% C	C:N
5-13	No	68.2		42.5						
5-23	No	59.1		37.1						
5-24	No	66.1		40.8		No	-	.72	36.2	50.3
5-27	No	66.2		35.3						
5-28	No	42.2		44.1						
5-29	No	39.9		39.5		No		.67	34.2	51.0
5-31	No	-	.59	37.2	63.1					
6-3	No		.72	36.4	50.6	No		.82	38.2	46.6
6-4	No		.64	40.2	62.8					
6-5	No		.83	34.0	41.0	No		.70	40.7	58.1
6-6	Yes		.47	39.4	83.8					
6-10	Yes		.62	32.9	53.1					
6-11	Yes		.57	32.2	56.5					
6-12	Yes		.55	-		Yes		.71	-	
-13	Yes	64.3	.61	38.4	63.0	Yes	57.6	.59	43.6	73.9
6-14						Yes	55.4	.56	39.7	70.9
6-17	Yes	71.9	.63	37.4	59.4	Yes	47.6		39.1	
6-18	Yes	56.7	.39	47.1	120.8	Yes	45.1	.57	31.2	54.7
6-19	Yes	38.2	.52	42.6	81.9					
6-20	Yes	65.9	.49	38.1	77.8	Yes	54.2	.73	35.7	48.9
7-3	Yes	34.9	.40	42.0	105.0	Yes	57.4	.82	41.2	50.2
7-8	Yes	45.7	.67	42.7	63.7	Yes	51.4	.69	38.7	56.1
7-12	No	56.5	.79	41.9	53.0	Yes	57.2	.56	41.9	74.8
7-15	No	43.8	.56	40.3	72.0					
7-16	Yes	36.9	.82	41.6	50.7					
7-17	Yes	54.0	.74	40.9	55.3	Yes	38.0	.64	33.0	51.6
7-17						No	38.0	.54	35.1	65.0

APPENDIX H

DAILY COLIFORM INDICES

1. Raw Ground Refuse Moistened with Water

Date	Composite Sample Size	Confirmed MPN/gm.	Fecal MPN/gm.
5-27	55g.	2.3×10^6	0
		1.9×10^6	0
5-28	78g.	7.8×10^3	7.8×10^3
		6.1×10^5	6.1×10^3
5-29	97g.	1.3×10^7	1.3×10^7
		9.4×10^6	9.4×10^6
5-31	40g.	4.4×10^7	4.4×10^7
		4.1×10^7	4.1×10^7
6-3	31g.	1.7×10^6	1.2×10^6
		1.0×10^6	1.0×10^6
6-4	68g.	2.2×10^6	1.2×10^6
		1.8×10^4	1.8×10^4
7-8	125g.	1.3×10^8	0
		1.4×10^8	0
7-10	124g.	1.9×10^4	1.9×10^4
		1.6×10^4	1.6×10^2
8-28	28g.	2.9×10^5	0
		4.1×10^6	0

2. Raw Ground Refuse Moistened with Sewage Sludge

Date	Composite Sample Size	Confirmed MPN/gm.	Fecal MPN/gm.
6-7	42g.	6.5×10^7	6.5×10^7
		6.5×10^6	6.5×10^4
6-10	81g.	6.5×10^6	6.5×10^6
		6.5×10^3	6.5×10^3
6-11	93g.	2.1×10^6	2.1×10^6
		2.1×10^6	2.1×10^3
6-12	90g.	1.6×10^6	1.6×10^6
		1.6×10^6	1.6×10^6
6-13	80g.	2.1×10^7	2.1×10^7
		2.1×10^7	2.1×10^3
6-17	45g.	4.4×10^5	2.6×10^5
		3.1×10^5	2.0×10^5
6-18	39g.	2.4×10^3	0
		2.4×10^3	0
6-19	21g.	4.2×10^8	1.4×10^6
		4.2×10^8	1.4×10^6
6-25	45g.	9.8×10^6	1.1×10^6
		9.1×10^5	9.5×10^4
6-26	82g.	7.5×10^7	7.5×10^7
		7.5×10^6	7.2×10^6

APPENDIX H
(Continued)

3. Compost with Sewage Sludge

Date	Composite Sample Size	Confirmed MPN/gm.	Fecal MPN/gm.
6-5	42g.	1.6×10^5	1.6×10^5
6-12	48g.	1.6×10^3	0
		9.4×10^3	0
6-13	40g.	7.9×10^3	7.9×10^3
		4.8×10^3	3.1×10^2
6-14	39g.	1.6×10^5	0
		2.1×10^4	2.0×10^1
6-17	21g.	1.8×10^4	1.8×10^4
		1.4×10^4	0
6-18	35g.	1.5×10^2	1.5×10^2
6-25	55g.	2.9×10^5	0
		3.1×10^4	0
6-26	21g.	2.1×10^4	0
		2.9×10^3	0

4. Compost without Sewage Sludge

Date	Composite Sample Size	Confirmed MPN/gm.	Fecal MPN/gm.
5-29	35g.	2.4×10^7	2.4×10^7
		2.4×10^6	2.4×10^5
6-3	29g.	5.6×10^6	2.1×10^6
		4.9×10^6	2.1×10^6
7-8	21g.	8.1×10^6	2.1×10^5
		2.9×10^6	2.1×10^5
7-10	48g.	2.4×10^4	2.4×10^4
		2.4×10^4	2.4×10^1
9-16	62g.	6.5×10^7	6.5×10^7
		6.2×10^6	6.2×10^4

OTHER SOLID WASTE DEMONSTRATION PROJECT REPORTS:

Project No.	Grantee	Report
D01-UI-00004	City of Madison. Wisconsin	Solid waste reduction/salvage plant; an interim report, City of Madison pilot plant demonstration project. Cincinnati, U.S. Department of Health, Education, and Welfare, 1968. 25 p.
D01-UI-00018	City of Santa Clara, California	Solid wastes landfill stabilization; an interim report. Cincinnati, U.S. Department of Health, Education, and Welfare, 1968. 146 p.
D01-UI-00026	Quad-City Solid Wastes Committee Paterson, New Jersey	Quad-City solid wastes project; an interim report, June 1, 1966 to May 31, 1967. Cincinnati, U.S. Department of Health, Education, and Welfare, 1968. 192 p.
D01-UI-00038	District of Columbia *Final Report: Phase 1*	Special studies for incinerators; for the Government of the District of Columbia, Department of Sanitary Engineering. Public Health Service Publication No. 1748. Washington, U.S. Government Printing Office, 1968. 80 p.
D01-UI-00060	City of Des Moines, Iowa	Collection and disposal of solid waste for the Des Moines metropolitan area; a systems approach to the overall problem of solid waste management; an interim report. Cincinnati, U.S. Department of Health, Education, and Welfare, 1968. 326 p.
D01-UI-00073	American Public Works Association Research Foundation, Chicago, Illinois	The Tezuka refuse compression system; a preliminary report. Cincinnati, U.S. Department of Health, Education, and Welfare, 1969. 47 p.
D01-UI-00080	Metropolitan Sanitary District of Chicago	Land reclamation project; an interim report. Cincinnati, U.S. Department of Health, Education, and Welfare, 1968. 338 p.